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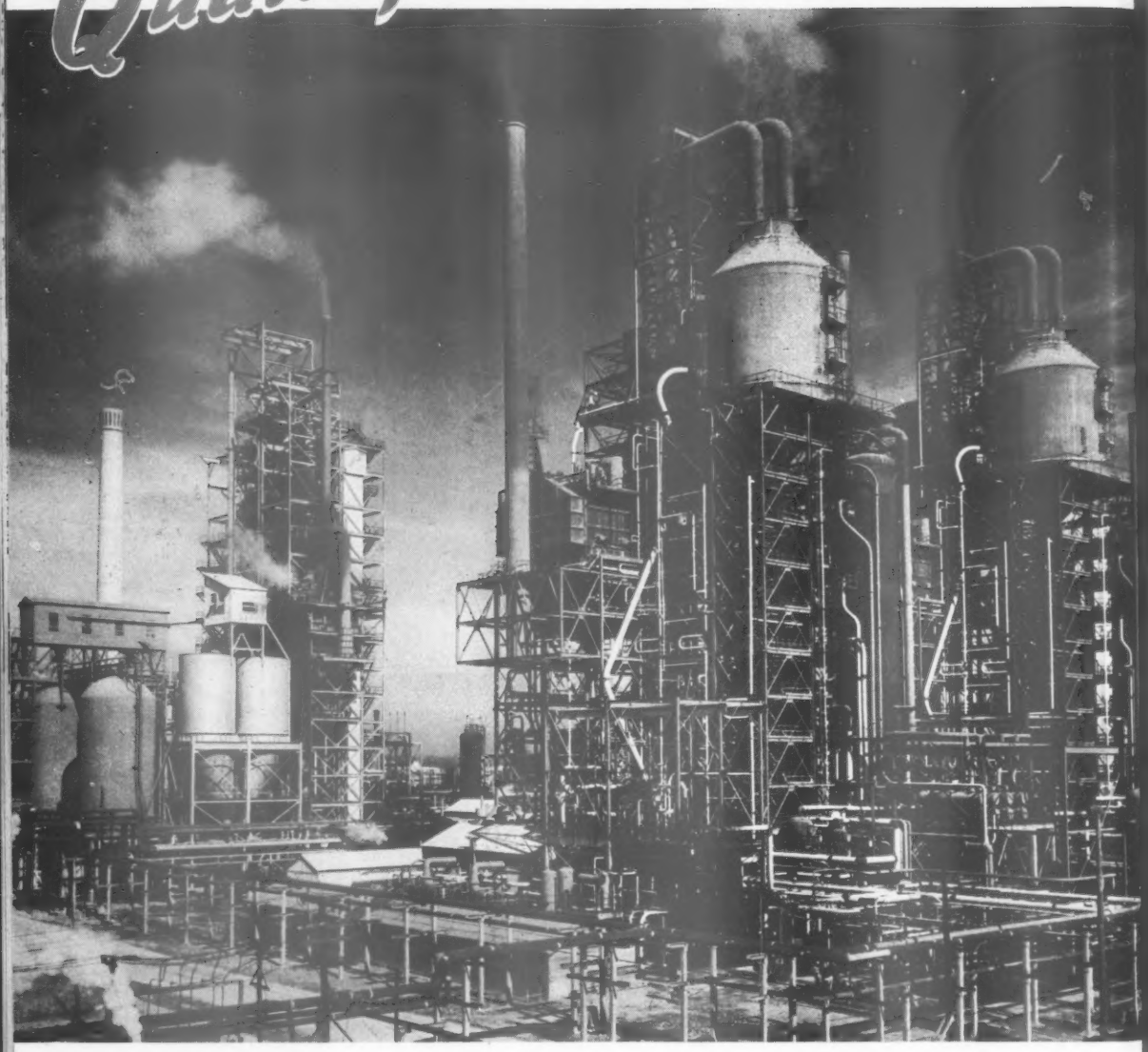

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Subscription price, United States and foreign, 1 year, $6.00; 2 years, $10.00; 3 years, $12.00; 5 years, $15.00. Single copies, 20 cents. Back copies, when over a year old, 50 cents. Entered as second-class mail matter at Tulsa, Okla., under Act of March 3, 1879. Copyright 1944, by The Petroleum Publishing Co.

Vol. 43, No. 9 July 8, 1944

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Trends

Crude-Oil Production
By States—Page 164

CRUDE-OIL STOCKS 229,332,000 bbl. as of June 24—down 1,233,000 bbl. One year ago 242,657,000 bbl.

GASOLINE STOCKS 86,000,000 bbl. as of June 24—up 732,000 bbl. One year ago 78,960,000 bbl.

RESIDUAL FUEL-OIL STOCKS 52,757,000 bbl. as of June 24—up 740,000 bbl. One year ago 67,240,000 bbl.

GAS OIL AND DISTILLATE STOCKS 34,328,000 bbl. as of June 24—up 191,000. One year ago 32,232,000.

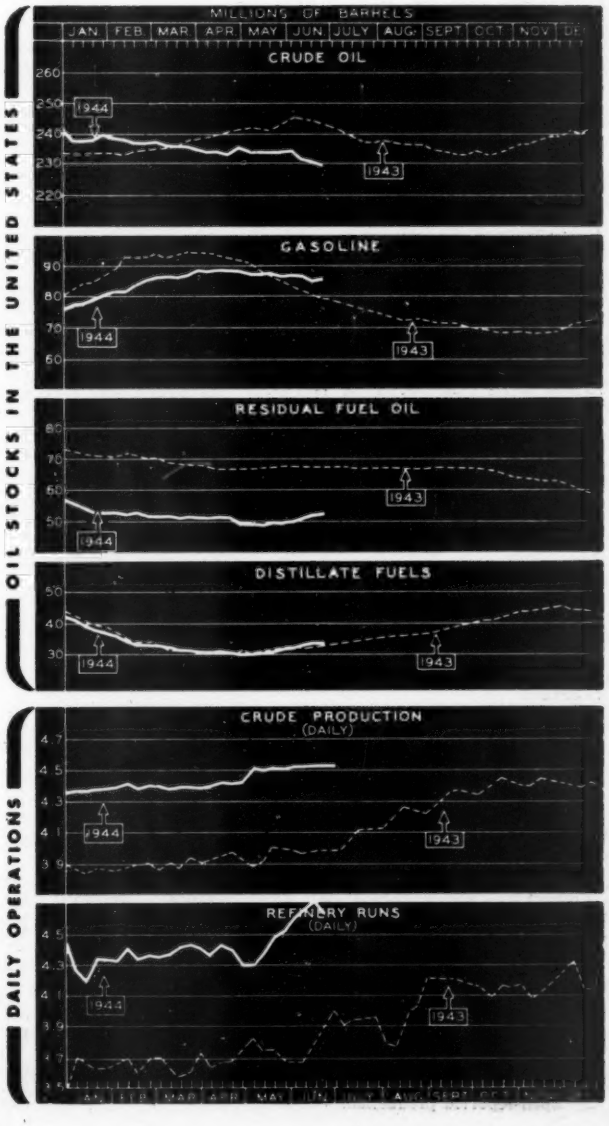
CRUDE-OIL PRODUCTION 4,582,500 bbl. daily average week ended July 1—down 1,870 bbl. Year ago 3,996,445.

REFINERY RUNS 4,638,000 bbl. daily week ended June 24—down 114,000 bbl. Year ago 4,007,000 bbl.

PRELIMINARY data reveal that producers of crude oil and natural gas in the United States completed 9,821 wells during the first half of this year. While less than the desired total for the first 6 months as projected by the Government's plan of 24,000 wells in 1944, the drilling for the half-year represents an increase of 22 per cent over the first half of 1943. There has been a steady climb in drilling operations since early May, and this trend will be further emphasized in completion records for the second half.

A COMPARISON of the drilling record for the last week in June with the same period last year reveals interesting trends. Most of the expansion is accounted for by West Texas, Texas Gulf Coast, Illinois, Oklahoma and California. The two Texas areas, where 51 more wells were completed last week than during the corresponding week of 1943 account for 86 per cent of the increased production in that state and 72 per cent of the national gain. The growth in drilling in the two areas, however, in relation to the conspicuous rise in production, is small. California, which ranks next to the two Texas areas in higher output, has also expanded its drilling operations. Drilling work has been increased in Oklahoma and Illinois, with current production about the same as a year ago. In the case of Illinois the greater activity reflects the easing of drilling restrictions through exceptions to spacing requirements, and in Oklahoma the expansion is due to West Edmond and other smaller discoveries.

THE probable scope of drilling operations with the ending of governmental restrictions and the return of normal conditions in manpower and materials, is indicated when current operations are compared with those for the same period in 1941. While crude-oil production has increased 722,000 bbl. daily over the past 3 years, drilling completions in late June 1941, were at the rate of approximately 90 daily, or nearly 40 per cent greater than the present level of operations. With the exception of the five areas previously mentioned present drilling for the most part is substantially under the levels of 3 years ago. The contraction in drilling now compared to 3 years ago is outstanding in the Pennsylvania Grade area with present operations about 40 per cent under the midyear of 1941.



Necessity for Intensifying Drilling Stressed by Producibility Report

HOUSTON. — The inexorable necessity for sustained development drilling during the next 6 months in the six southwestern oil states comprising Petroleum Administration for War District 3 was emphasized here last week by another interim report on the projected productive capabilities of all existing fields in that territory.

The report was compiled by the District 3 subcommittee on reserves and development headed by John S. Ivy, Houston. The subcommittee's study concluded that fields in the six states are capable of sustained production over the next 6 months of 2,640,514 bbl. daily. The calculated productive capacity is 159,269 bbl. per day less than the June allowable and nearly 200,000 bbl. a day below the District 3 production quota certified by PAW for July. The PAW July quota, however, includes 194,500 bbl. daily of natural gasoline and condensate at least half of which is not calculated in the Ivy subcommittee report.

Neither the types of crudes necessary for the war effort nor the adequacy of field tankage and pipe-line capacities that would be necessarily involved in making the volumes indicated available for refinery utilization were considered by the subcommittee in arriving at its conclusions.

"The committee determinations," explains the covering letter attached to the report, "represents average rates or sustainable rates for the 6-month period ending December 31. Subsequent considerations will necessitate revisions of the present report as additional data concerning completions, abandonments, and reservoir performance are obtained."

Detailed information on individual fields was classified in three major divisions: (1) most wells producing at capacity; (2) inefficient rate, remedial measures believed impracticable; (3) new field, tentative rate. From the subcommittee's field classification, it is obvious new fields offer the best prospect of overcoming the projected deterioration of productive capacity in District 3, the area which currently supplies nearly 60 per cent of the total domestic output of crude oil. Reversal of the production curve, it is disclosed by analysis of the report, will depend chiefly on scope and rapidity of development drilling in the newer fields.

BARRELS PER DAY—JULY 1, 1944

State and district—	April production	June allowable	Committee determination	Additional availability over April production
Alabama	35	*35	300	+265
Arkansas:				
Uncontrolled	19,406	*19,406	17,960	—1,446
Controlled	53,099	58,212	51,404	—1,695
Total	72,505	77,618	69,364	—3,141
Louisiana:				
North	65,200	77,767	55,429	—9,771
South	282,108	299,763	281,370	—738
Total	347,308	377,530	336,799	—10,509
Mississippi	41,231	*41,231	40,070	—1,161
New Mexico:				
Northwestern	1,312	*1,312	1,067	—245
Southwestern	111,274	109,859	108,277	—2,997
Total	112,586	111,171	109,344	—3,242
Texas:				
District 1	22,039	25,253	21,226	—813
District 2	131,069	150,598	138,069	+7,000
District 3	480,890	531,381	476,451	—4,439
District 4	185,739	205,162	183,738	—2,001
District 5	36,064	43,030	42,776	+6,712
District 6	451,238	479,029	487,240	+36,002
District 7-B	27,123	32,557	25,601	—1,522
District 7-C	18,956	22,265	23,024	+4,068
District 8	365,254	453,293	486,689	+121,435
District 9	118,113	142,229	112,203	—5,910
District 10	88,828	107,401	87,620	—1,208
Total	1,925,313	2,192,198	2,084,637	+159,324
Grand total District 3	2,498,978	2,799,783	2,640,514	+141,536

*April reported production.

PAW Is Urged to Give Production Manpower High Priority Rating

HOUSTON. — Every effort should be put forth by Petroleum Administration for War "to see that the exploration, drilling, production and oil-field servicing phases of the oil industry . . . be given a high priority rating on the War Manpower Commission's national priority list," according to a resolution adopted at a meeting here last week of the production manpower subcommittee. Attention of R. V. Shirk, chief of PAW's manpower section, was directed to the resolution.

Drilling of exploratory wells is 24 per cent behind PAW's requested program, the resolution said. Crude production is insufficient to keep all refineries operating to full capacity. Crude withdrawal is being increased to the point where wells, owing to pressure decline, must be equipped with artificial lift, which in turn requires increased maintenance personnel.

According to Ray Horton, chairman of the production manpower subcommittee, the industry's District 3 recruiting plan has met with more success in obtaining men for drilling and production work than had been expected. The plan went into effect the first part of May. At the close of the second week in June 193 men had been recruited by the various districts (see April 6, 1944, issue of The Oil and Gas Journal, page 28, for districts).

Most of the recruits were untrained as far as drilling and production work is concerned.

In discussing the recent War Manpower Board order that all changes in jobs must clear through the United States Employment Service, it was brought out that the ruling should have no adverse effect upon the recruiting program, since the various districts were already working with the U.S.E.S. According to Lynn Brown, director of the war manpower committee for the Houston area, at points where there are no U.S.E.S. offices, drilling and production men may be employed without first contacting the office. He pointed out, however, that in cases of this kind the nearest office should be advised.

Arch Rowan, recently appointed on the Petroleum Industry War Council, resigned as chairman of the production manpower subcommittee. He will continue serving as a member of the committee.

Plans are being made to request a high priority rating for highly skilled nontechnical men, such as oil-well perforators, geophysical shooters, directional drilling experts and others vital to the oil industry.

Government's Covetous Glances At Oil Reserves Held Alarming

by Henry D. Ralph

WASHINGTON. — A warning that the entire oil industry must remain on guard against government attempts to control huge reservoirs of petroleum in the ground for purposes of future naval reserves has been sounded by Reginald W. Ragland, assistant to the president, Richfield Oil Corp., in an analysis of the recently enacted Elk Hills legislation and the attitude of the Navy expressed before Congress.

While the final form of the law was vastly different from the draft submitted by the Navy, so much so, in fact, that President Roosevelt criticized it severely in signing it, Ragland declares it still contains elements of the original "joker" which would permit the Government to gain control of large reserves by condemnation and prevent production for indefinite periods.

The principles espoused by Navy spokesmen during hearings on the bill have significance far beyond their local application to Naval Petroleum Reserve 1 in California, and constitute a threat wherever the federal Government owns land on which oil has been or may be discovered, Ragland contends. Even in Texas, which has no federal public lands, and in many other states, the Government owns many tracts through acquisition of forest lands, parks, airports, military installations, or through foreclosure of government loans. The principle which the Navy attempted to apply to Elk Hills could be used to create new naval petroleum reserves and to extend their boundaries indefinitely.

Under the theory Ragland attributes to the Navy, the president, by executive order, could create a petroleum reserve out of any land owned by the federal Government. Then the "exterior limits" of such a reserve could be extended to the entire pool underlying the new reserve, and such lands could be condemned to prevent drainage of the reservoir. In cases where the reserve thus extended overlapped another pool "of the same geologic structure," even in a different horizon, the boundaries of the reserve and the power of condemnation could be extended to include the second pool, and this process might go on almost indefinitely in certain areas of intensive oil production.

While the Elk Hills act now requires that the Navy obtain the consent of House and Senate naval affairs committees before condemning additional lands in Naval Petroleum Reserve 1, Ragland points out that some government officials still adhere to the belief that the only way to insure an adequate supply of petroleum for the military forces in time of war is to keep reserves locked up in the ground undeveloped. To refute this theory he cites the experience of the present war as showing that the armed forces must depend on commercially developed production and that the entire oil industry of the nation is at the Government's command in time of war.

The "joker" in the Elk Hills bill as drafted by the Navy is apparent only after a detailed study of the history and geology of Naval Petroleum Reserve 1. Ragland's analysis goes into the technical facts to develop the Navy's theory that a "continuation of beds" theory would permit condemnation of all lands threatening drainage of the naval reserve. He also asserts that the Navy's bill would have permitted a huge extension of the reserve through application of the "same geologic structure" theory. It so happens that the "exterior boundaries" of Elk Hills as recently extended by executive order, includes a tract on which oil has been discovered from the Stevens zone at a greater depth and from a different pool than the so-called shallow zone of the Elk Hills reserve. Ragland cites statements of Navy witnesses during hearings on the legislation to support the contention that the Navy was following a plan by which it could gain control of the entire Stevens zone by reason of this overlapping.

"Thus the plan is unfolded," says Ragland. "Here were the contemplated steps:

"1. Extend the exterior boundaries of Reserve No. 1 into the geologic structure of another oil field that never threatened drainage of the original reserve. There will then be lands within the reserve that are on the same geologic structure as an oil field outside the reserve.

"2. Since an oil field eventually drains directly or indirectly all parts of itself, even to its edges, and since the exterior boundaries of the reserve had been extended to include a segment of the 'productive formations' of the oil field outside the reserve, 'which would be subject directly or indirectly to drainage of petroleum from any other locations on such structural feature or trap,' the situation would be within the exact language of the Vinson bill, even as amended.

"3. All the conditions or 'hurdles' found in the language 'on the same geologic structure, provided that drainage exists' would then be met and the outside oil field could be condemned.

"A natural corollary to such a plan would be that the United States having acquired title to the outside oil field, the Navy could then procure another executive order extending the exterior boundaries of the reserve to include the condemned field, and, if possible, reach out and include a segment of still another oil field, provided a similar or analogous situation could be found."

Higher Ceilings Granted Two Fields

WASHINGTON. — The Office of Price Administration has granted increases in the crude-oil price ceilings for two fields, effective July 10, to bring ceilings up to prices for crude in the surrounding territory and under agreement with the refiners that the increases will be absorbed.

Vacherie (Hester) field, St. James Parish, Louisiana, is given a ceiling of $1.30 a barrel for 40° gravity and over, with the customary 2 cents off for each degree of gravity under 40. Current production of this field is about 70 bbl. a day of 39° gravity crude oil, and about 30 bbl. a day of distillate of approximately 45° gravity. Producers had been receiving $1.30 a barrel for the distillate and $1.19 a barrel for crude oil of 34° gravity and above. Thus, today's increase will provide a rise of 9 cents a barrel on the crude, from $1.19 to $1.28 a barrel for the usual 39° gravity oil. No increase is provided for the distillate.

Alta Mesa field, Brooks County, Texas, is granted a ceiling of $1.45 a barrel for 40° gravity and over, with the customary 2 cents off for each degree of lower gravity crude. Improvement has been made in the delivery facilities, and it is expected that, instead of the 250 bbl. per day which were handled last year, approximately 1,600 bbl. per day can be moved from the field. The new ceiling of $1.45 a barrel represents an increase of 12½ cents a barrel.

Refiners Pledge Maximum Aviation Gasoline Production

WASHINGTON.—Operating executives of refineries producing 100-octane gasoline last week pledged themselves to manufacture every possible gallon of aviation fuel during the next 90 days at a called conference with Allied military authorities and representatives of other American war agencies. Specific details were left to the judgment of each individual refiner but they were told all possible details of how badly needed are additional supplies to continue the global advantages already achieved by the military forces.

"Give us more and more high-octane aviation gasoline" was the plea of Army and Navy officers and Petroleum Administrator Harlod L. Ickes. Fifty-five presidents and vice presidents of United States refineries manufacturing 100-octane gasoline responded to the call for an off-the record conference June 29 at Washington with the Allied military leaders. Oil men were given a complete picture of aviation gasoline requirements which have shot up to unprecedented quotas since the European invasion began.

Army and Navy officials gave the refiners a report of what has happened and what is happening in the various theaters of war. The meeting was addressed by Gen. H. H. Arnold, Air Marshal Sir William L. Welsh, of the Royal Air Force, and Adm. D. C. Ramsey, chief of the Bureau of Naval Aeronautics. They urged the refiners to push their plants to the limit to "give us the stuff that powers the attack."

"The oil industry has never failed to deliver in this war and it will not fail to do even the impossible now—again," Administrator Ickes declared. No information was made available on the value of aviation gasoline currently requested by the military leaders. However, at a recent plant dedication in Texas, Deputy Administrator Ralph K. Davies reported that production would "soon rise to 500,000 bbl. daily" and it is assumed, therefore, that current requirements are equal to or above that figure. Davies reported later in the week that 80 per cent of the authorized projects in the 100-octane program of the United Nations have been completed.

One hundred and eighty-nine separate projects were involved in the program of which 150 have now been completed. Seven of the total were built in 1942, 71 in 1943 and 72 have been finished so far this year. Of the remaining units, 25 are expected to be ready this summer and the balance during the fall.

He gave the following breakdown of the 100-octane construction program by type of installation (some of the installations include more than one unit of a particular type):

Type of unit—	Completed	Building	Total
Alkylation	56	13	69
Isomerization	26	9	35
Fluid catalytic cracking	26	7	33
Thermofor catalytic cracking	10	6	16
Houdry catalytic cracking	9	1	10
Houdry catalytic cracking*	4	...	4
Hydrogenation	2	2	4
Dehydrogenation	2	...	2
Miscellaneous	15	1	16
Total	150	39	189

*Revamping.

George H. Smith to Head A.G.A. Natural Gas Staff

NEW YORK.—George H. Smith, currently on the staff of a government agency in Washington, will become director of the Natural Gas Department, American Gas Association, effective August 7, it was announced here this week. The post of director of the Natural Gas Department has been vacant since E. Holly Poe was granted leave to serve as chief of the Petroleum Administration for War Natural Gas and Natural Gasoline Division. Poe later was made director of the Petroleum Reserves Corp. and recently resigned to enter private business.

GEORGE H. SMITH

War-Oil Shipments Granted Preference

WASHINGTON.—The Office of Defense Transportation has ordered all oil companies and railroads to give shipments of petroleum war products preference over all other tank-car shipments because of emergency military demands.

Oil companies are ordered to carry on loading and shipping operations every day including Sundays and holidays, and available tank cars are limited to a 1-day supply for each company. No tank cars may be removed from East Coast service for use on the West Coast or elsewhere without special ODT permission. Railroads are ordered to speed up deliveries and reduce turnaround time of petroleum tank cars and to reroute oil trains when necessary to maintain delivery schedules.

Increase Anticipated in Demand for Motor Fuel

WASHINGTON.—Demand for motor fuel in July is estimated by the Bureau of Mines in its monthly forecast analysis at 67,700,000 bbl., an increase of 19 per cent compared to the same month a year ago. June demand was estimated at 64,600,000 bbl. of motor fuel.

The daily average supply of domestic crude oil estimated to meet the market demand this month is 4,603,200 bbl., 10.9 per cent greater than in July 1943.

"Additional data now available for the second quarter of 1944," the bureau reported, "indicate that motor-fuel demand and supply will approximate closely the previous forecasts. Recent expansion in war requirements, however, has led to further large gains in refinery runs and the demand for domestic crude petroleum may prove to be over 2 per cent greater than was anticipated. The increased demand for crude petroleum has been met primarily by heavy withdrawals from storage although production has shown a moderate gain in recent weeks."

U.S.S.R. Acquires Rights to Manufacture Neoprene

WILMINGTON, Del. — As the result of negotiations undertaken at the request of the U. S. Government, E. I. du Pont de Nemours & Co. is making its neoprene synthetic rubber process available to the Soviet Union, the company announced this week.

THIS WEEK

PRODUCTION—Revised estimates on producibility of District 3 fields reemphasizes necessity of increasing development drilling. . . . ¶Sustainable production rate for last 6 months calculated at 2,640,514 bbl. daily, or 159,269 bbl. under the June allowable. . . . Area covered accounts for 60 per cent of nation's crude production. . . . ¶PAW and manpower agencies implored to place production personnel on high priority rating. . . . Heavy withdrawals speeding installation of artificial lifting equipment—requiring technical and experienced personnel. . . .

REFINING—Eighty per cent of 100-octane projects, totaling 150 installations, completed. . . . Remaining 39 plants to be finished this summer and fall. . . . ¶Fifty-five top refining executives pledge manufacture of increased volumes of aviation gasoline—from existing facilities—answering plea of military leaders. . . . ¶Industry faces demand for 67,700,000 bbl. of motor fuel this month, up 19 per cent from a year ago. . . . ¶Domestic fuel-oil viscosities limited in District 5, to stimulate production of Navy requirements. . . .

REGULATIONS—Revised PAO-11 and Supplementary Order 12 liberalize restrictions on drilling in District 3. . . . Changes meet most complaints of southwestern operators. . . . Multizone development authorized but 40-acre spacing for individual pools sticks. . . . Rules on installation of pumping equipment in East Texas modified to achieve maximum efficiency. . . . Other objectives of District 3 producers to be met by administrative orders. . . .

DRILLING—Exploratory drilling, District 3 committee reports, is 24 per cent under PAW goal. . . . ¶National completions, exploratory and development, rose to year's peak last week. . . . ¶Pleas incessant from operators for more rigs, more crews—locations declared available. . . . ¶Questions of adequate completions and concomitant sufficiency of production focused more sharply on materials and manpower. . . .

TRANSPORTATION—Two closely coordinated divisions created by War Shipping Administration to handle all tanker movements and cargoes. . . . ¶East Coast deliveries over land declined slightly. . . . Tank cars handled 690,048 bbl. daily for week ended June 24, off 25,383 bbl.; two WEP lines delivered 481,822 bbl., down 14,185 bbl. . . .

SUPPLIES—National stocks of civilian-grade gasoline drop 829,000 bbl., totaling 46,870,000 bbl. . . . Comparable prewar inventory (May 31, 1941) totaled 77,789,000 bbl. . . . ¶Crude stocks dwindle to wartime low of 229,332,000 bbl., no permanent relief from withdrawals in prospect, probably for duration. . . . Five million barrels removed from stocks in 3 weeks of June. . . . ¶East Coast stocks of gasoline (civilian) and crude lowered 457,000 bbl., week ended June 17—combined fuel-oil inventory rose 639,000 bbl., same week. . . .

News spotlight of the week was turned on this group of high-ranking military officials who explained rising demands to the Petroleum Administrator and representatives of 100-octane manufacturing companies. Seated are Air Marshal Sir William L. Welsh, of the RAF; Administrator Ickes, and Gen. H. H. Arnold. Standing: H. Wilkinson, British petroleum representative; Deputy Petroleum Administrator Ralph K. Davies; Harry G. Burks, Jr., chairman of the aviation gasoline advisory committee, and Adm. DeWitt Ramsey, chief of the Navy Bureau of Aeronautics

Public Domain Problems Discussed at Compact Meeting

by T. R. Ingram

DENVER.—The quarterly meeting here of the Interstate Oil Compact Commission on June 30-July 1 was turned into an open forum for a discussion of problems arising out of the dual administration of oil and gas operations on the public domain by federal and state governing bodies and the remedies which may be applied for the betterment of existing conditions. Registrations, of which there were 124, included members of the commission, governors of four states, members of both branches of Congress, representatives of state regulatory bodies, Washington bureaus, and western oil men. Indications of a better understanding and a more cooperative attitude were apparent throughout the meeting and this trend was emphasized when Ralph J. Schilthuis, assistant director of production, Petroleum Administration for War, announced amendments to PAO-11 relaxing a number of restrictions.

Views of western oil men were expressed by Gov. John C. Vivian, of Colorado, in his welcoming address when he advocated the lessening of Washington control and the omission of the many "don'ts" which hinder the wildcatter. He urged government cooperation and more of the spirit which brought about the development of mining in the early days, and expressed the belief that Congress and the Washington bureaus were beginning to see the light and were adopting a more conciliatory attitude.

"The way to develop more oil is to allow us to go out and prospect for it as we did in the early mining days," Governor Vivian said. "If you can find a better way, we will go along with you."

Hiram M. Dow, commission member from New Mexico, brought out a new angle to the problem in the federal government policy of handling its mineral rights in land newly acquired. The public-land states, he said, grew to greatness because of a liberal policy in disposing of the public domain, but this policy no longer exists. In recent times, he said, the federal Government has been reacquiring land at a rapid rate. Lands have been acquired by 27 different governmental agencies. He pointed out that the Department of Agriculture has, as of January 30, 1943, 162,752,608 acres. This, with land controlled by the Department of the Interior, constitutes 95 per cent of all land owned by the Government. The Department of Agriculture land being sold under the Bankhead-Jones Farm Tenant Act is subject to a reservation on behalf of the United States of not less than three-fourths of all the coal, oil and other minerals under such property. On May 16, 1944, the secretary of agriculture pretended, Dow said, to place on the market these minerals for lease under rules and regulations, not for the disposition of federal coal, minerals and oil, but for government ownership and operation. He described it as a "fake" leasing method to cover up government ownership, although the Bernard M. Baruch report on war and postwar adjustment policy proposes that "leasing must not become a hidden device for government ownership or subsidies."

Sen. Carl Hatch, of New Mexico, chairman of the Senate committee on public lands and a member of its subcommittee to study the western mineral situation, declared that what should be done to secure maximum development of the public domain is to rewrite the Oil Leasing Act. He said that what he heard here seemed to be a policy tending to restrict development and hold the domain for the profit of the federal Government, but that is not the history of this country. It was never the intention of the federal Government to control the land in the states, but to develop it in the interest of the citizens and the state within which it is located. History shows that the policy is to place the land in private ownership. The administration of the land has to be carried on under the laws passed by Congress. The conflicting interpretation of the laws should be eliminated by a program that is clear, defined and coordinated and he believes that it can be worked out by rewriting the Mineral Act in cooperation with the members of the oil industry and to so define the laws that there can be no misinterpretation. He especially pointed out the desirability of a definite and permanent royalty policy on the same basis as commercial leases and that this should not be on any temporary emergency basis.

Thomas S. Harrison, consulting geologist of Denver, who has been identified with oil development in the Rocky Mountain area for many years, gave a talk on the oil and gas prospects in this area in which he predicted that the proven, drilled and undrilled reserve is about equal to the 752,000,000 bbl. which Wyoming and Montana have produced to date. He said the picture is favorable and assuring, the time opportune, and he foresees for the Rocky Mountain province successes well worthy of the quest now in progress.

At the conclusion of the meeting, Gov. Andrew F. Shoeppel, Kansas, chairman of the commission, announced the resignation of Charles L. Orr, secretary of the commission, and called upon Gov. Robert S. Kerr to express the sentiments of the members. In token of appreciation, they presented him with a war bond of unstated denomination. E. G. Dahlgren, assistant secretary, was appointed temporarily to Orr's position.

Discussing engineering problems at the compact meeting are G. A. Gallie, Arkansas; W. H. Carson, Oklahoma; E. DeGolyer, Texas; John Kelly, New Mexico; E. Stephenson, Kansas, and F. M. Van Tuyl, Colorado

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

End the Pussyfooting

As additional agencies of the Government, with varying objectives and powers, acquire land in this country the dangers inherent in public ownership become more and more apparent. The reports at the recent National Conference of Petroleum Regulatory Authorities, which were also discussed at the Interstate Oil Compact Commission meeting in Denver last week, revealed that 27 governmental agencies now own 455,000,000 acres of land in this country, almost a fourth of the total area.

The accepted policy of this country until recent times provided that public lands, except for parks, military reservations and other similar governmental uses, and the mineral rights of these lands, should be disposed of to private owners as they were needed. The rights of ownership after sales had been made were the same as those applying to other private property. Under this plan, around which new frontiers were constantly established and natural resources steadily developed, public lands were simply held in trust by the Government and disposed of for the common good as private demands arose.

Now these lands are rapidly becoming political footballs, kicked around by various departments and agencies in any manner that will serve their particular ends. Total acreage is increasing, not decreasing. New regulations, which are the backdoor method of establishing permanent controls and ownership, reject accepted business practices.

All that has been done directly affects the future search for petroleum under these public lands. Federal officials appear determined to discourage in every way possible the development of oil areas by private operators without regard to the rights of states and 130,000,000 consumers.

The matter of oil royalties is a case in point. Through a sliding scale of higher payments the departments of Interior and Agriculture, which are the principal owners of these public lands, propose largely to ignore in the future the one-eighth royalty around which the petroleum industry has been built over the past 85 years. They offer nothing to compensate for this additional burden to private operators.

Statements of federal officials at hearings and elsewhere reveal that they have little conception of the part that the royalty interest plays in the operations of the petroleum industry. The one-eighth basis was established as a reasonable return to the landowner.

In actual practice this royalty participation becomes through trading a part of the oil industry and in a very real way is one of the active forces which are constantly on the search for new oil. A substantial part of the royalty revenues is returned to the oil industry and reinvested in those operations designed primarily to find new fields.

This basic condition obviously does not apply in cases where the royalty payments are made to government agencies. To encourage full-scale operation, the governmental participation as oil-royalty owner should be less, not more than that of private owners.

The enforcement of announced policies will be interpreted as evidence that Washington is curtailing or ending private oil development with the view of forcing permanent governmental ownership and operation. In an election year there should be no further pussyfooting as to the real issues in this nation's public land objectives.

Revised PAO-11 Meets Requests Of Southwestern Operators

by Henry D. Ralph

WASHINGTON. — The revision of Petroleum Administrative Order 11, announced July 1 by the Petroleum Administration for War, meets almost entirely the requests for relaxation of drilling restrictions which were made to PAW by the production committee of District 3 at a recent meeting in Houston, Tex., with Deputy Administrator Ralph K. Davies.

Those requests not covered either will be taken care of by administrative action or were impossible for PAW to meet because of the prevailing policies of the War Production Board relating to priorities and control of materials.

How Requests Were Met

The District 3 committee made seven requests, as follows:

1. Eliminate the distance provisions with respect to oil-well drilling in states having regulatory bodies.

This request was met by Paragraph C of the new Supplemental Order 12 to PAO-11.

2. Relax restrictions as to size of drilling units in conformity to state regulations.

This was met in full by Paragraph C of SO-12, since all federal restrictions on distances are removed.

3. Permit independent development of separate pools in a single field.

Since PAW found it too complicated to draft a regulation which would cover this, the objective will be attained administratively. It is now the policy to grant individual field-wide exceptions, based on local geological conditions, on application of the operators. These exceptions will generally be handled by the PAW District 3 office, subject to policy determination in Washington.

4. Permit reworking a well in the same pool from which it previously produced without restriction.

This was met in full by Subparagraph H-4 of the revised PAO-11, nation wide except for the provisions of outstanding Supplement 1 to PAO-11 applying to gas-well spacing in the Appalachian region, northeastern Oklahoma, and Missouri.

5. Require that a well drilled for oil but completed as a gas or condensate well be operated under the 640-acre rule.

This was met as to gas wells on a nation-wide basis by Subparagraph F-5 of PAO-11. Condensate wells will be handled by individual exceptions in accordance with existing procedure, since conditions surrounding condensate wells were considered too unpredictable to permit writing a general regulation.

6. Permit gas wells to be drilled without federal restrictions except the 640-acre unit rule.

This was met in full by Subparagraph F-5 of PAO-11.

7. The use of second-hand pumping equipment should not be limited to any particular well density.

This was met in Paragraph I of PAO-11 as to both new and second-hand equipment, in full and nation wide except that in East Texas the unrestricted use of pumping equipment is permissible only where the Texas Railroad Commission permits the transfer of allowables between wells on the same lease.

The action taken to meet request No. 7 of the District 3 committee also met the request of a special East Texas committee, which asked that any operator be permitted, at his option, to increase the efficiency of production, to install second-hand lifting equipment on all wells, which previously has been in conflict with the provisions of Section i of Paragraph 3 of PAO-11.

The revised PAO-11 also complies with three requests made by the natural gas and natural gasoline committee, as follows:

1. The $5,000 limit on priorities for natural-gas gathering lines should be raised to $10,000.

This was done as to the ceiling on total cost, but WPB would not permit the use of the high priority ratings given maintenance and repair work for projects costing this much. However, the new PAO-11 wipes out the four former materials-control clauses, and WPB's priority order P-98-B was revised last week to permit the automatic application of high "MRO" priority ratings to $500 worth of material on such projects. The balance of the material, up to $10,000, may be obtained on slightly lower priority ratings.

2. A similar request as to natural gasoline and cycling plants. This was met to the same extent as the provisions regarding gas-gathering lines.

3. When a gas well is drilled on a 640-acre unit it should be (a) 1,320 ft., from a lease or property line, (b) 3,960 ft. from another drilling or producible well, (c) separate properties must be consolidated, and (d) after a 15-day test period, if in a "restricted area," the gas may be used for field use, exclusive of gas lift, without PAW approval.

These requests were all met in full by Paragraph F-5 of PAO-11, in the same way as requests 5 and 6 of the District 3 committee.

It is probable that similar modifications as to the $10,000 and $500 limits will be made in PAO-15, which restricts the use of materials in refining and transportation branches of the industry.

Text of Supplementary Order 12

(Applicable in the states of Arkansas, Louisiana, Mississippi, New Mexico and Texas.)

Section 1515.18, Supplementary Order 12 to Petroleum Administrative Order 11, as amended July 1, 1944.

A. Scope of this order.—Except as otherwise modified by the provisions of any other order issued as a supplement to Petroleum Administrative Order 11, as amended July 1, 1944, or by the provisions of any exception issued pursuant to Paragraph (n) of Petroleum Administrative Order 11, as amended July 1, 1944, the provisions of this supplementary order shall to the extent provided herein be applicable to the use of material in petroleum production operations in the states of Arkansas, Louisiana, Mississippi, New Mexico, and Texas, but not elsewhere.

B. Definitions.—The definitions of Petroleum Administrative Order 11, as amended July 1, 1944, shall apply in this supplementary order.

C. Authorized uses of material in oil development drilling operations. — Material may be used to drill, complete, and provide additions to, any well for the purpose of producing oil, except in a "restricted area," if there is compliance with the following provisions:

1. The well must be located on a drilling unit consisting of at least 40 contiguous surface acres upon which no other drilling or producible well is located.

2. The drilling unit upon which the well is located must not be attributed in whole or in part to any other drilling or producible well.

3. The distance between any two points farthest apart on the drilling unit upon which the well is located must not exceed a distance of 2,100 ft.

4. All separate property interests in the drilling unit upon which the well is located must first be consolidated.

5. The well must be drilled with due diligence to maintain a vertical well bore.

However, a well may be intentionally deviated from the vertical if the surface location of the well (in this case, the place on the surface directly over the bore hole at the lowest level at which the well is open to production) conforms to the other provisions which have been set out above. Where a well is intentionally deviated from the vertical, a directional survey of the well bore must be filed with the director of production of the district in which the well is located within 30 days after completion of the well.

6. If any well completed in conformity with the provisions of this Paragraph (c) is completed as a gas or condensate well, it shall not be produced except to provide fuel for drilling or fuel for other lease operations, or for testing the well for a period not exceeding 15 days, and no material may be used to produce the well or provide additions therefor, except as necessary for such purposes, until authorization has been granted by an authorized official of the Petroleum Administration for War.

D. Authorized uses of material for deepening and recompletion of wells.

1. Material may be used to deepen and recomplete any well in another pool, if, with respect to the pool in which the well is to be deepened and recompleted, there is compliance with the provisions of Subparagraphs (c) (1), (c) (2), and (c) (4).

2. Material may be used for the multiple completion of any well deepened in conformity with Subparagraph (d) (1).

3. If any well completed or recompleted in conformity with the provisions of this Paragraph (d) is completed or recompleted as a gas or condensate well in any pool not theretofore opened for production to the well, it shall not be produced from such pool except to provide fuel for drilling or fuel for other lease operations, or for testing the well for a period not exceeding 15 days, and no material may be used to produce the well from such pool or provide additions therefor, except as necessary for such purposes, until authorization has been granted by an authorized official of the Petroleum Administration for War.

E. Authorized uses of material for installation of pumping or other artificial lifting facilities.—Material may be used to install or reinstall pumping or other artificial lifting equipment, including a central pumping power unit, or to install additional tubing or sucker rods on any well located in the East Texas field, Upshur, Gregg, Smith, Rusk, and Cherokee counties, Texas, only if:

1. The pumping or other artificial lifting equipment is installed or reinstalled on a well located on a lease where the Railroad Commission of Texas permits, under its duly issued rules or regulations, the transfer of allowable oil production from any well on such lease to another well or other wells on the same lease.

2. The pumping or other artificial lifting equipment is reinstalled on the same well to which it was connected at the time any operation authorized under Paragraph (h) of Petroleum Administrative Order 11, as amended July 1, 1944, was initiated.

3. The pumping or other artificial lifting equipment is installed on any well deepened or recompleted in conformity with Subparagraph (h) (5) of Petroleum Administrative Order 11, as amended July 1, 1944.

4. The pumping or other artificial lifting equipment is installed on or connected to a well located on any lease or tract where the number of wells to which pumping or other artificial lifting equipment is then attached does not exceeed an average of one well to every 10 productive acres.

5. The pumping or other artificial lifting equipment is installed on a well located on any lease or tract of 10 acres or less whereon no other well is located to which pumping or other artificial lifting equipment is already attached, but in no event may a lease or tract be subdivided or rearranged for the purpose of making this provision applicable.

6. The pumping or other artificial lifting equipment is transferred in its entirety from one well to another well located on the same lease or tract.

7. The pumping or other artificial lifting equipment is installed on a well which has been drilled pursuant to an exception to Conservation Order M-68, Petroleum Administrative Order 11, or any amendment or supplement to either of such orders, which exception contains no prohibition against the installation of pumping or other artificial lifting equipment.

8. The additional tubing or sucker rods are installed on a well to which there is already attached pumping or other artificial lifting equipment which has been regularly operated prior to the installation of the additional tubing or sucker rods.

F. Violations.—Any person who wilfully violates any provision of this supplementary order, or who, by any act or omission, falsifies records kept or information furnished in connection with this supplementary order is guilty of a crime and upon conviction may be punished by fine or imprisonment.

Any person who wilfully violates any provision of this supplementary order may be prohibited from delivering or receiving any material under priority control or may be subject to other appropriate action.

G. Effective date.—This supplementary order shall take effect July 1, 1944.

Twelve Rigs Are Assigned to Increase Elk Hills Production

WASHINGTON.—Drilling will begin immediately in the Elk Hills field, with Standard Oil Co. of California assigning 12 strings of tools to the task of adding 300 wells to the present 234 and increasing production to 30,000,000 bbl. during the next 18 months. Further expansion will be carried forward as crews and tools are available.

The plans were officially announced by the Navy Department following last week's presidential approval of two agreements between Navy and Standard of California under which the production of Naval Petroleum Reserve 1 will be quadrupled to fill growing oil needs for the Pacific war theater.

The two agreements approved by President Roosevelt and immediately executed by Navy and Standard of California are (1) a unit contract under which Standard surrenders to the Navy control of its lands in the reserve but is permitted to produce and use 15,000 bbl. of oil per day for refining into war products, and (2) an operating agreement under which Standard of California undertakes, at absolute field cost, to provide the extra production of Navy oil which will be sold to the highest qualified bidder for preparation for war use. Production will be increased to 65,000 bbl. a day.

The increased production, the Navy said, will come entirely from the shallow oil zone, since the types of crude in this pay are extremely high in both octane and lubricating qualities. The producing section is divided into the first and second sub-Scalez zones and the Mulinia and sub-Mulinia zones.

Average depth of the proposed new wells will approximate 3,000 ft. Surface spacing will be one well per 10 acres, but since a differentiation will be made in the sands from which the wells are to be completed, the subsurface spacing will be one well per 20 acres. The oil sands in the Scalez zone, Navy said, have characteristics which indicate that recoveries of oil in place per acre-foot of sand should be as high as any other field in California. The oil in place in the Scalez sand is estimated to be over 1,500 bbl. per acre-foot. By developing and withdrawing oil uniformly over the field and by utilizing the most advanced primary and secondary-recovery methods, it is hoped that the greatest possible ultimate recovery of oil in place will be obtained.

Capt. William G. Greenman, U.S.N., recently returned from active duty, will succeed Rear Adm. H. A. Stuart as director of the Office of Naval Petroleum Reserves and will be in direct charge of Elk Hills operations. Captain Greenman is a former inspector of Naval petroleum reserves in California.

Admiral Stuart has been closely connected with Navy oil since 1918, when he worked with fuel oil and gas supplies. In 1924, he became inspector of Naval petroleum and oil shale reserves for Wyoming, Colorado and Utah, and later came to the Washington bureau of the Navy of which he became chief.

Louisiana July Allowables Slightly Under June's

BATON ROUGE.—July oil allowables are slightly under the June average of 395,080 bbl. daily, the minerals division of state Conservation Department announced last week. The July allowables, totaling 389,224 bbl. daily, follow: Houma 61,516, Lafayette 105,700, Lake Charles 68,128, New Orleans 77,392, Monroe 31,596, Shreveport 44,892.

Continuous Consultation Seen As Basis for World Oil Accord

CONTINUOUS consultation as the method for international coordination of oil production is regarded as the probable outcome of American and British conversations on the subject by Herbert Feis, former economic adviser to the State Department. Feis, who expresses his views in the current issue of Foreign Affairs, rules out the possibility that an allocation system on an accord patterned after the interstate oil compact will be adopted. His observations are based on "the well-established character of the matters at issue, the statements to the press and the circumambient reports that come to an interested observer."

There are influential advocates of an international agreement like those that have operated in other commodity fields such as rubber, sugar and coffee, he says, all of which contemplate the allocation of total demand among the producing sources.

"My summary opinion is," he writes, "that there is virtually no chance that an allocation scheme could be negotiated. Among the many difficulties that negotiators would face is the strong wish of almost all producing areas to proceed unhindered with development; the uneven impact of an agreement upon the financial interests engaged in oil production; the inadequacies of knowledge concerning reserves; unexpected tides in the flow of different fields; and the recurrence of important new discoveries. In short it would be too formal and too confining a dress for so acrobatic a branch of production as the oil industry."

Conservation Idea Unworkable

The proposal, influentially supported by Americans, that countries combine in a program of production control based on the principle of conservation would not be satisfactory, Feis states. "The rate at which supplies should be withdrawn from under the ground in order to be most highly useful would certainly differ greatly as between different oil-bearing structures; no identical fractional formula would fit them all. Incentive for conservation would also differ greatly as between countries. For example, a small country interested only in revenue from exports would almost necessarily take a different view of the question than a large power which might find possession of adequate domestic supplies a deciding factor in its military position in time of crisis. Again the volume of production that might be set by estimates of conservation requirements might at any given time accord badly with the market position. For these and other reasons a world accord of the character suggested would be too rigid, would be inadequate and would likely become a disguise for the fulfillment of other purposes."

Feis ventures the conclusion that "any kind of hard-and-fast international agreement for the regulation of supply should be avoided. A modest and guarded approach will be well advised. . . . In short, the method that recommends itself for the international coordination of production is continuous consultation, guided by agreed principles and carried into effect by the informal acceptance of those who control the main sources of supply, under the gaze of governments combined in council."

Equal Opportunity Supported

One of the first questions discussed at the American-British conference was the belief of each party that the other at times tried to hinder or exclude its oil enterprises from obtaining any new concessions or extending those already acquired, Feis reports. This led to an agreement to support a policy of "equal opportunity."

"All the oil interests represented were drawn together by a common anxiety: the spreading disposition of foreign governments to exclude all foreign enterprise and to transform all branches of the native oil industry into government monopolies. The oft-repeated denials of any monopolistic intention both by the British and American governments translated itself into support for what in the United States has become known as the open-door policy. This would presumably mean the application of some role of equality of opportunity." The immediate area of application would include most of the important proven sources of oil supply except the U.S.S.R.

This, however, developed fears that equality of opportunity might "create unmanageable disturbances in established currents of the petroleum trade. . . . These fears have an important place in the minds of oil-producing interests when faced with any proposal that the restraints upon opportunities for exploration and production be rudely lifted. . . . Proposals for further substantially increasing Middle Western production —whether by construction of the trans-Arabian pipe line or through removal of present restrictive accords — immediately met the question as to how they would fit into the future world supply and demand situation." All who have a stake in other oil producing properties believe that development of Middle Eastern oil "must be accommodated to all other elements in the oil-production situation and that the solution must be found in some world-wide program of coordinated production."

Responsibility Accepted

Heightened recognition on the part of American and British interests that their control over so great a part of the world's oil resources carries an international responsibility was an outcome of the conferences, according to Feis. "They soon came to recognize that the policies adopted to govern the development of these resources must represent more than an adjustment between contending American and British interests. It was seen that the task lying ahead requires that the peoples in the producing areas be assured of receiving equitable, nay generous, consideration of their interests; and that all nations dependent on sources of supply outside their own boundaries be assured that they would be available in ample quantity, at low cost, and on substantially equal terms. The conferees were compelled, and the governments in the future will be compelled, to take this responsibility seriously."

Tanker Operations Put Under New WSA Divisions

WASHINGTON.—Two new, closely coordinated divisions will handle all matters related to tanker allocations and operations, the War Shipping Administration announced last week.

B. B. Jennings, formerly assistant deputy administrator for tanker control, was named director of the Division of Tanker Allocations, reporting directly to the deputy administrator for vessel utilization and responsible for all matters relating to the employment and allocation of the use of tankers, movement of tanker cargoes and questions of policy.

J. W. Bancker, who has been serving as executive assistant to Jennings, was named director of the Tanker Operations Division, reporting to the assistant deputy administrator for ship operations and responsible for all activities related to the physical operations of WSA controlled tankers.

TUBE-TURN WELDING FITTINGS—RANGE OF SIZES
TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES
SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".
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The FIRST SEAMLESS WELDING FITTINGS 1ST AND STILL THE BEST
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Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge Nominal Pipe Size	Light Gauge Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"- 3"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"	¾"-30"*	1"-12"	1"- 8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"- 8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	¾"-24"	¾"-24"	1"-12"	1"- 8"		
Tees	Reducing Outlet	¾"-24"	¾"-24"	¾"-12"	1"- 8"		
Reducers	Concentric & Eccentric	¾"-24"x20	¾"-24"x20		1¼"-12"x10		
Caps		1"-24"	1"-24"		1½"- 8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**	**				
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"**	**				

*30° size short radius.
** Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"- 4"		¼"-3½"			
Socket Type	¼"-24"	¼"- 4"		¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Reducing-threaded or slip-on	¾"-24"	¾"-24"	¾"-24"†	4"-12"	3"-12"	1"-12"	
Orifice—threaded		1"-24"	4"-12"				
Orifice—slip-on		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Orifice—welding neck		1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	
Long Welding Neck	1"-24"	1"-24"	1"-10"				

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

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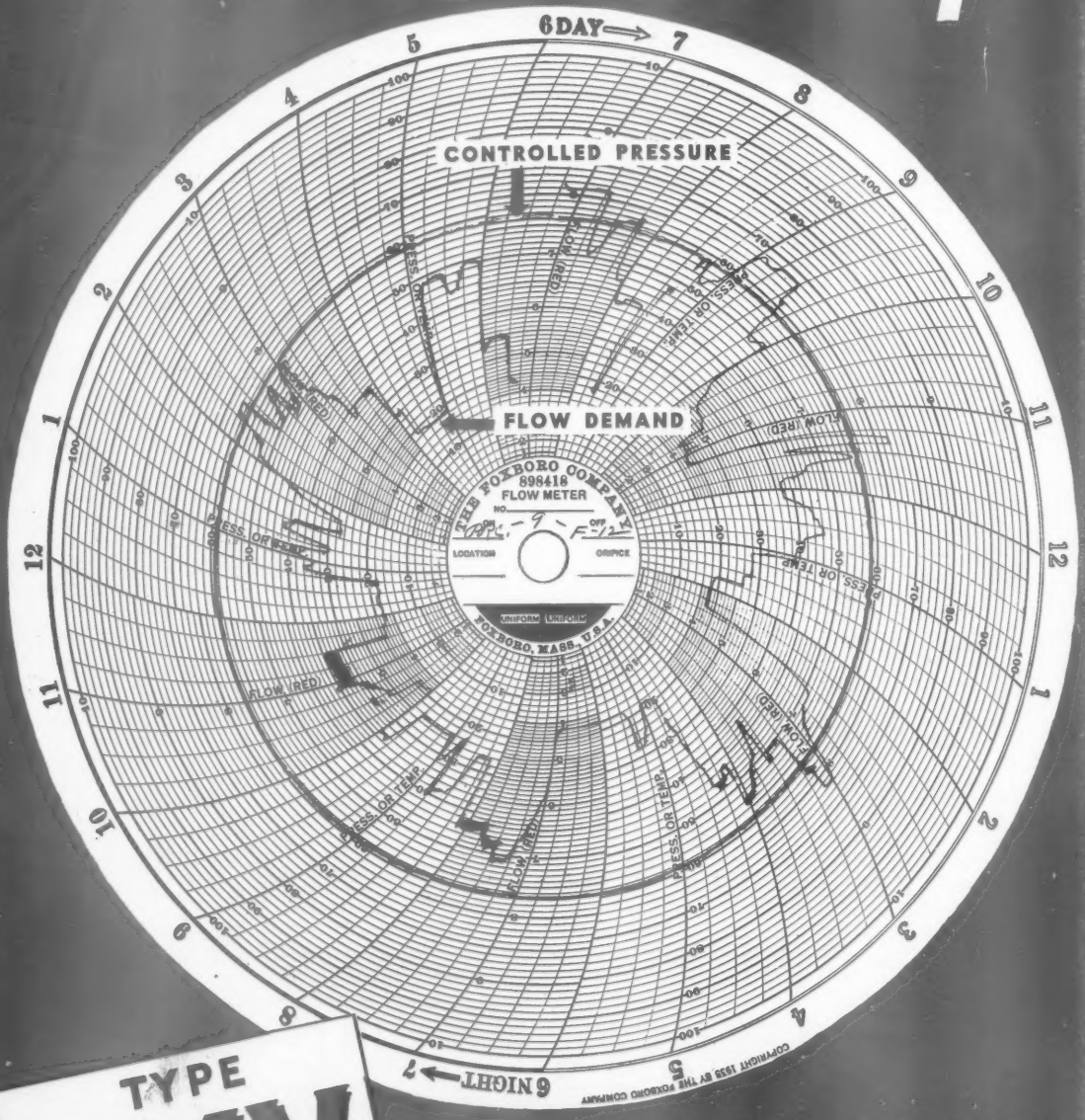

Reproduction of actual chart showing almost perfect outlet pressure maintained by 2-G-MV six-cylinder and one G-MV four-cylinder compressors, operating simultaneously under automatic speed control in a large ammonia cracking plant.

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For Responsiveness

For versatility to meet all kinds of operating conditions . . . for positive responsiveness to the most sensitive automatic controls . . . Cooper-Bessemer G-MV's are outstanding.

The pressure and flow readings on the chart opposite show the almost perfect performance of three G-MV's in actual service under widely fluctuating load. With straight line unloading from 100% to 12%, the automatic speed controls plus cylinder unloading were able to keep discharge pressure almost unvarying.

These reliable and specially developed automatic controls are only one of the outstanding features of the G-MV. Other features that contribute to its versatility include precision bearings, positive ignition, proper air-fuel distribution, scientific cooling and correct balance. Rugged, compact, representing the most advanced engineering and design principles from engine bed to ignition system, the G-MV compressor is built for long, trouble-free, low-cost operation.

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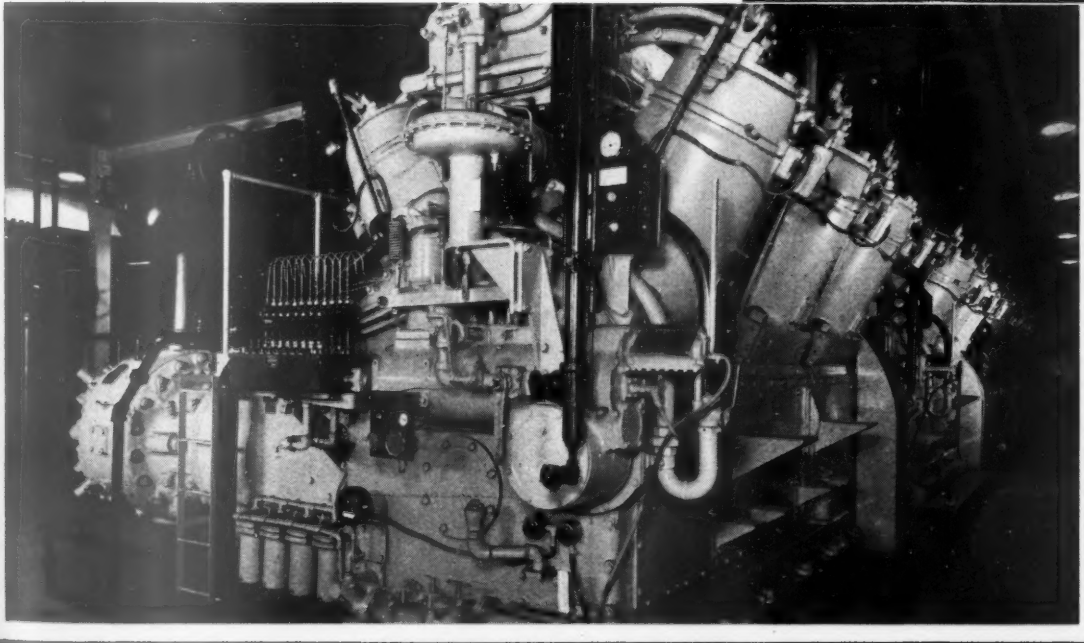
The unique automatic controls developed by Cooper-Bessemer allow practically constant maintenance of pressure output, within very close limits, despite wide variation in demand, speed, torque and time-cycle functions.

This automatic speed control —with or without compressor cylinder unloading—is a unique Cooper-Bessemer development, designed to meet the precise requirements of modern processing industries and is available on all G-MV compressor units.



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Minimum Viscosities Set for District 5 Fuels

WASHINGTON. — Minimum viscosities for various grades of civilian fuel oils to be manufactured, delivered, or received in the Pacific Coast states were announced June 28 by the Petroleum Administration for War.

Action was taken by issuance of a formal order (Petroleum Distribution Order 22) which became effective on June 28 and applies only to PAW District 5 (California, Oregon, Washington, Arizona and Nevada).

Viscosity minima for the various grades of fuel oil listed by PDO 22 follow:

Furnace oil—not less than 43 Saybolt Seconds Universal at 100° F.; light domestic oil—not less than 35 Saybolt Seconds Furol at 122° F.; bunker grade fuel—not less than 150 Saybolt Seconds Furol at 122° F.; and railroad and heavy industrial fuel—not less than 200 Saybolt Seconds Furol at 122° F.

New Fuel Rationing Director Appointed

WASHINGTON.—Appointment of John G. Neukom as director of the Fuel Rationing Division was announced this week by Charles F. Phillips, deputy administrator for rationing of the Office of Price Administration.

Neukom, who has been assistant director of the division and chief of the Fuel Oil Rationing Branch, has been with OPA for more than 2 years. He went to OPA from the engineering firm of McKinsey, Kearney & Co., of Chicago.

Petroleum Pays 54.8% of Business Tax in Texas

DALLAS.—The oil industry paid 54.8 per cent of all business and property taxes collected by Texas in 1943, according to a preliminary analysis of the state comptroller's reports and the tax rolls of the 254 counties prepared by Texas Mid-Continent Oil and Gas Association.

"From all sources," the association says, "the state and its tax-levying subdivisions collected last year a grand total of $328,734,643, of which the petroleum industry and its products paid $134,260,726 or 40.8 per cent, compared with $194,437,917 or 59.2 per cent from all other taxpayers," the association said.

"Of the $99,101,573 in business and property taxes collected by the state from all sources, the petroleum industry paid $54,302,964. All other taxpayers paid $44,798,609 or 45.2 per cent.

"Business and property taxes collected were: $19,622,047 in state ad valorem taxes levied on county tax rolls; $36,295,690 in gross receipts taxes; $3,411,313 in franchise taxes; $25,655,304 in payroll taxes paid by the employer and $14,117,219 in other state taxes which include occupation, chain store, note stamp, charter fees, etc. Petroleum industry taxes include gasoline taxes and license fees paid in operation of oil-industry cars and trucks.

"Local ad valorem taxes collected by county, city, school, road and bridge and independent districts, totaled $156,189,683, of which the petroleum industry paid $43,356,100.

"The business and property taxes, $99,101,573, and the local ad valorem taxes, $156,189,683, total $255,291,256, of which the petroleum industry paid $97,659,604 or 38.3 per cent.

"Gasoline taxes paid by the motoring public amounted to $36,601,-661. The public paid to the state $23,674,151 in cigaret, liquor, wine, beer, prescription, auto sales, radio, cosmetic, playing card and other sales taxes. The total was $60,275,-812, of which the gasoline tax was 60.7 per cent."

Lion Takes Big Geophysical Option in Arkansas

EL DORADO.—What is described as the biggest geophysical option ever recorded in Arkansas has been taken by Lion Oil Refining Co., whose headquarters are in this city. Lion is reported to have agreed to drill 11 Paleozoic tests on 240,000 acres of International Paper Co., and on approximately 120,000 acres belonging to Fordyce Mill & Lumber Co. The lands are in Clark, Cleveland, Dallas, Grant, Jefferson and Hot Springs counties.

The tests for geological information only will be of the slim-hole type for which no state or Petroleum Administration for War permit will be necessary. Should oil be encountered in commercial quantity, it is to be expected that a well would be completed.

DEATHS

Bernard B. Devlin, 74, of Dallas City, Pa., oil producer for 50 years in the Bradford and Allegany fields, died June 25.

O. D. Underwood, oil producer of Olean, N. Y., died June 20. In 1909 he organized First National Bank of Eldred, Pa.

William P. French, 82, active oil producer throughout his adult life, died June 26 in Seneca, Pa.

William C. Hardison, 71, until his retirement drilling superintendent for Houston Oil Co., died June 24 in Houston. In earlier years he was a teaming and drilling contractor in many Texas fields.

Henry H. Cranston, 65, senior member of Henry H. Cranston & Son, drilling contractors, died June 24 in Fredonia, N. Y. He had been active in oil and gas fields of New York, Ohio, Pennsylvania and Kentucky.

Alex W. McCoy, 55, vice president in charge of the land and exploration department of Deep Rock Oil Corp. and nationally known geologist, died June 30 in Tulsa. Graduating from University of Missouri in 1914, he taught geology in University of Oklahoma, then was employed by the Marland interests and Cities Service Oil Co. For some time he was an independent consulting geologist.

R. W. Castle, 83, retired oil operator, died June 29 in Tulsa. In addition to his oil business he had real estate interests.

Lawrence E. Cooper, 55, former oil operator, died June 30 at his ranch home near Gravette, Ark.

F. H. Fillingham, 52, assistant general manager of sales for the eastern division of Standard Oil Co. of Indiana, died of a heart attack June 28 in Indianapolis. He had been with the company 31 years, starting as a stenographer.

George Leach, 70, retired superintendent of the Imperial Oil, Ltd., refinery at Regina, Canada, died recently at Sarnia. In 1896 he became associated with the Bushnell Oil Co. at Petrolia and continued with Imperial Oil when the latter took over the Sarnia plant. He was superintendent at Regina from 1922-33.

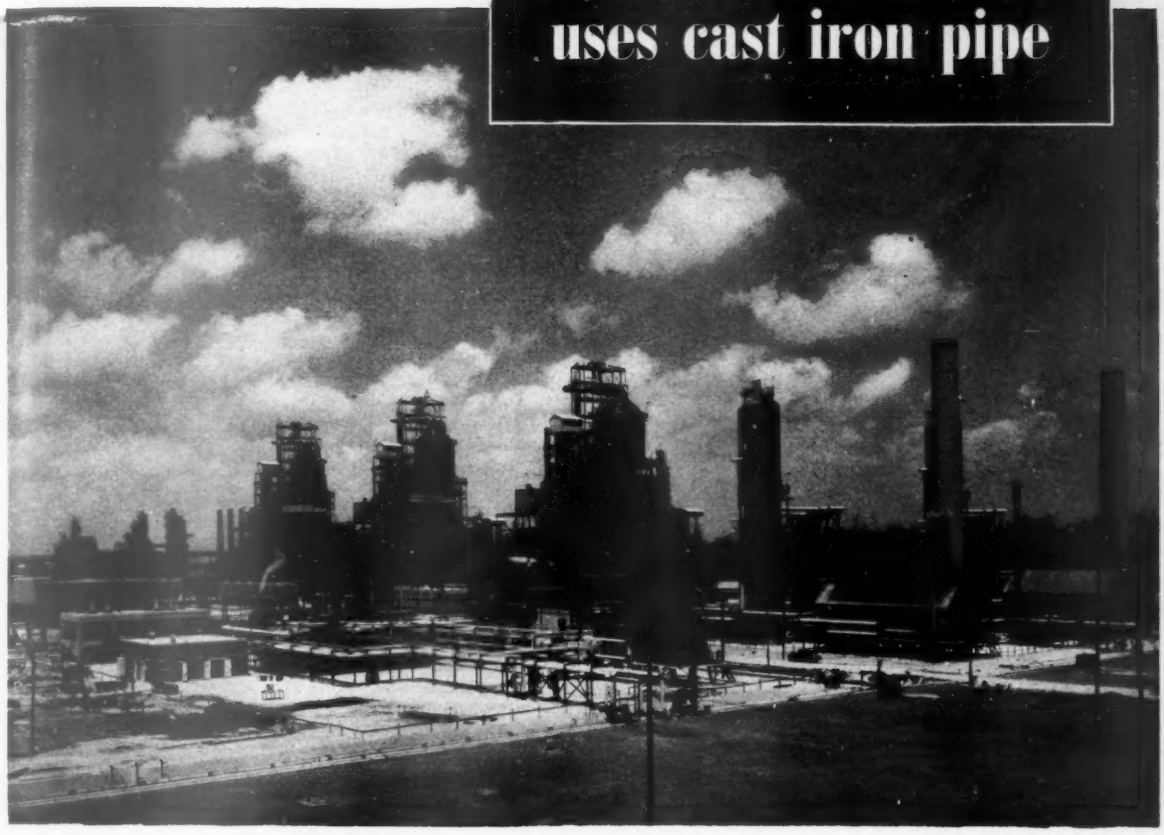
Thomas L. O'Neil, 63, for many years tax agent for the Dehoney-Babson interests, died last week in Los Angeles.

O. W. Reynolds, 59, field superintendent for George McGarr Oil Co., Big Lake, Tex., died July 1 in a San Angelo hospital.

Tilman A. Wood, 48, superintendent for Oklahoma Natural Gas Co. in the Oklahoma City district, was killed July 1 when struck by lightning on the links of Oklahoma City Golf and Country Club. He had been in the service of Oklahoma Natural since 1919.

Homer T. Whittekin, 63, died June 28 at Lockhart, Tex., of injuries suffered on an oil lease which he was operating. He had worked as driller, superintendent and drilling contractor in several states, including Indiana, Kansas and California.

CITIES SERVICE REFINERY uses cast iron pipe



Approximately 8 miles of 4-inch to 30-inch cast iron pipe has been installed in the new Cities Service 100-octane and butadiene plant at Lake Charles, La. This pipe is used for water, fire protection and sewerage lines laid underground. An additional 8 miles of cast iron pipe is used for condenser coils. Cast iron pipe is inherently and effectively resistant to corrosion. Its cost per service year is low. Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago 3, Illinois.

CAST IRON PIPE

For Longer Life and Economy

NEW PLANT DEDICATED TO WAR

W. ALTON JONES
Chairman of board, Cities Service Co.

by W. Alton Jones

THE production of our new Lake Charles high-octane gasoline and butadiene plants adds substantially to the flow of war materials which we all hope soon will crush the Axis powers.

We have one supreme objective. It is merged with the over-all objective of our country. It is to turn out these vital essentials of war in such quantity and of such quality as to hasten the day of victory. Our objective at Lake Charles is the objective of our country—the destruction of Hitler and of Hirohito, and of the kind of life for which they stand.

The Tutwiler refinery and the butadiene plant are peculiarly adapted to play an important role in Uncle Sam's production offensive. They constitute an engineering feat of the first magnitude, incorporating as they do, the latest and most efficient design and inventions. The equipment is of optimum quality—it's all brand new—everything has been done according to plan.

Here we hope to establish new and higher records of efficiency in the use of America's strategic oil reserves. Let me repeat here what I said at ceremonies dedicating the Lake Charles plant:

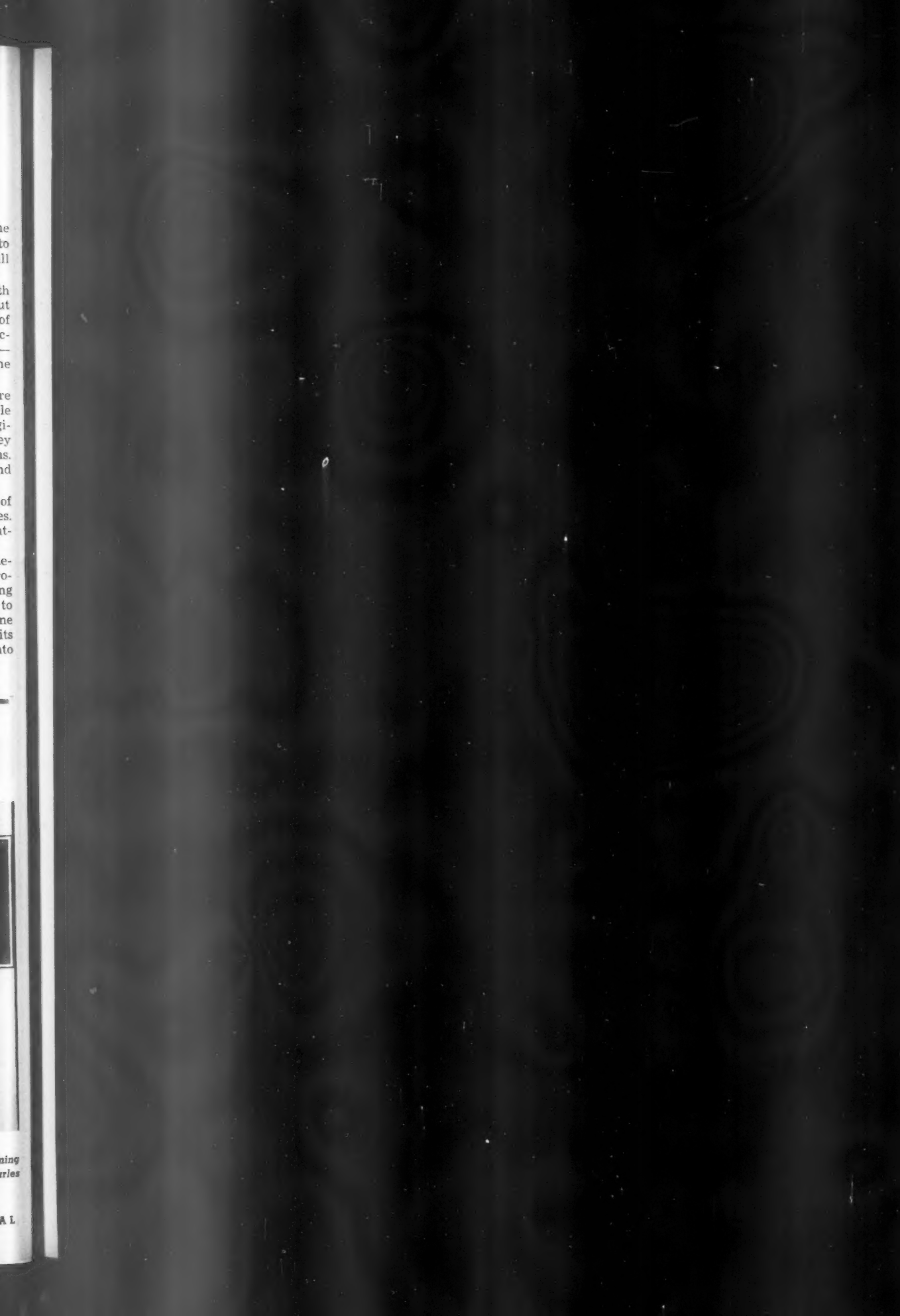
"We dedicate its activity to our boys on the battlefronts in the hope that the added material of war produced here may bring them home sooner, and bring more of them home! If the output of this plant helps to shorten the war by 1 day or to save the life of one American boy, the 25,000,000 man-hours put into its construction and the millions more that will go into its operation, will not be in vain."

TUTWILER HEADS CORPORATION WHICH BUILT LAKE CHARLES PLANT

MANY believe that without a doubt the envisioning, conception and completion of the Tutwiler refinery of Cities Service Refining Corp. at Lake Charles, La., which started operations this spring, is the greatest single achievement accomplished to date in the eventful industrial career of its president, T. W. Tutwiler. The entire project of building and operating this refinery is due largely to the energy, initiative and vision of this man. The scope and caliber of the huge manufacturing plant now in full operation show the capacity of the man who made a dream come true.

Temple W. Tutwiler was born in Cincinnati, Ohio, removed early to Birmingham, Ala., graduated from University of Alabama, and entered the coal and iron business in Birmingham. In 1911 he left the important executive position he had attained with United States Steel Co. to build and operate the Tata Steel & Iron Co. of Bombay, first large steel plant in India, at the behest of the British government. Returning to America in 1925, he managed his various private enterprises until 1930 when he became a director of the Cities Service organization. In 1935 he was placed in charge of that company's oil and gas interests; since then he has been especially active in planning and directing new facilities for the production of aviation gasoline, synthetic rubber, ammonium picrate for explosives, and other important war and industrial materials.

T. W. Tutwiler, president of Cities Service Refining Corp., looks at plaque dedicating the new Lake Charles refinery



A. P. FRAME
Vice president and chief engineer

WILLIAM W. LOWE
Vice president and general manager

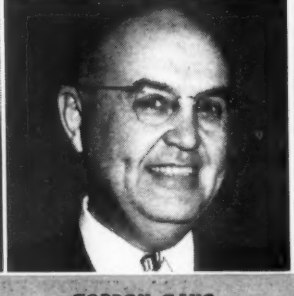
This staff has engineered and directed the planning, construction and operation of that refinery since its conception

C. E. GATELY
Counsel

E. W. KORSMEYER
Secretary

LLOYD A. LYND
Treasurer

B. R. MUIRHEAD
Manager of Sales



GORDON GANO
Manager crude-oil supply

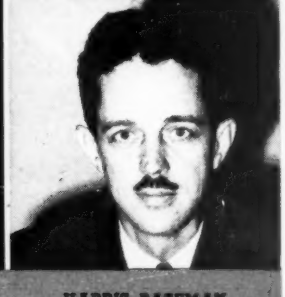
E. H. ROY
General superintendent

G. L. MATEER
Asst. general superintendent

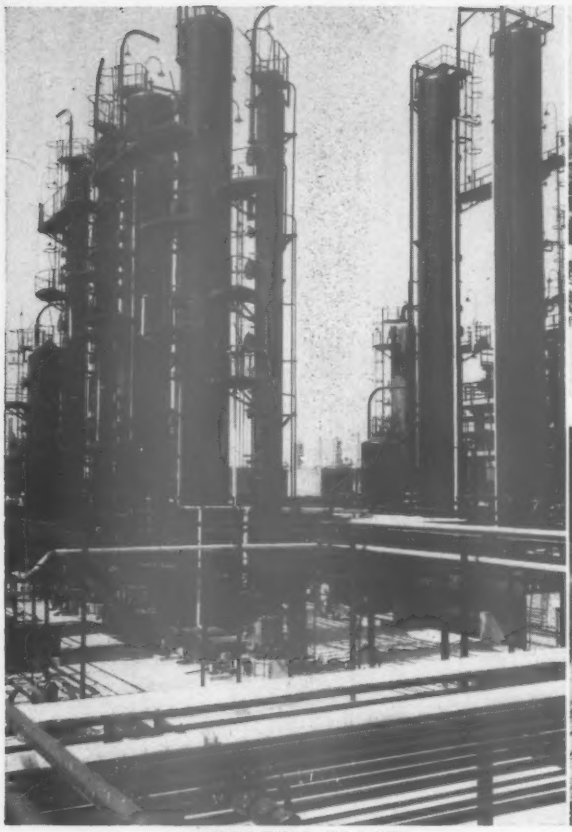
C. B. WHYTE
Supt. of construction

H. P. GOODMAN
M. W. Kellogg Co.

W. H. PRICE
Processing superintendent

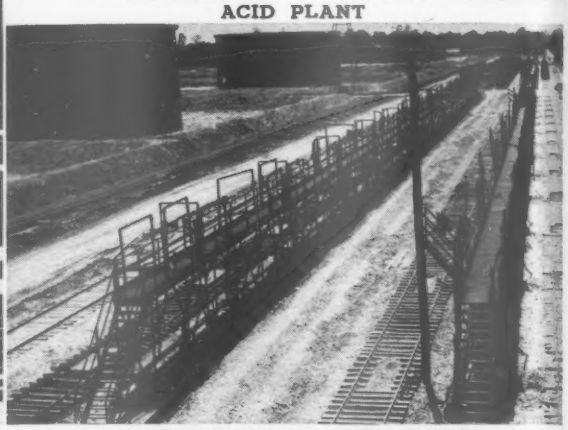


HARRIS BATEMAN
Purchasing engineer

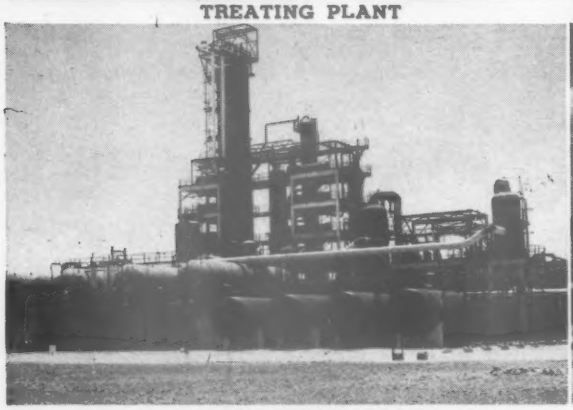


TREATING PLANT

ACID PLANT



TANK-CAR LOADING RACK

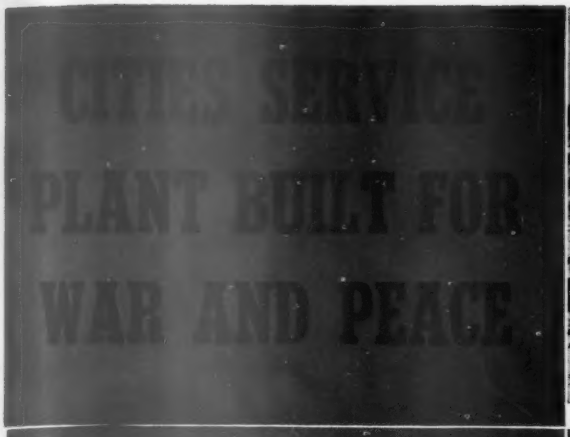


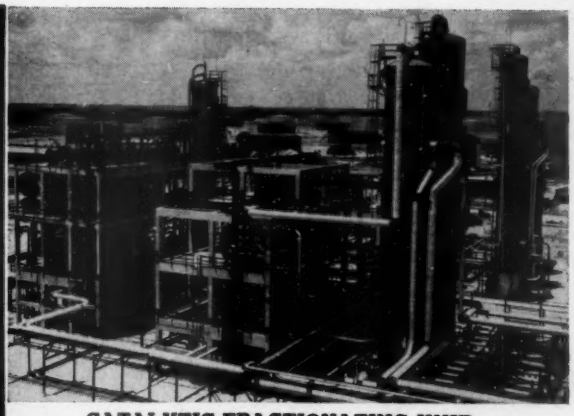
ALKYLATION UNIT

STRAIGHTRUN FRACTIONATING UNIT

WATER PUMP HOUSE

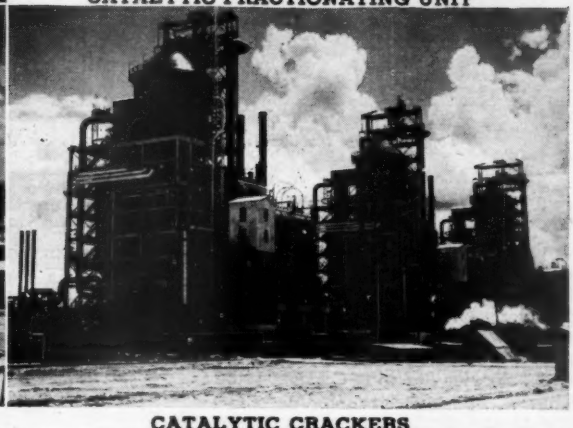
POWER PLANT





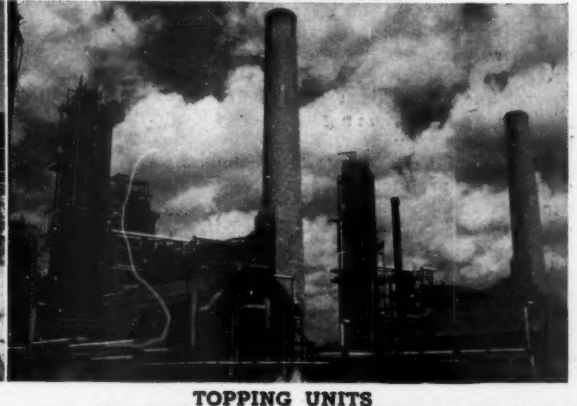
CATALYTIC FRACTIONATING UNIT

STORAGE AREA



CATALYTIC CRACKERS

DEASPHALTING-DESALTING UNIT



TOPPING UNITS

LABORATORY

ADMINISTRATION BUILDING

New Cities Service Plant Is "THE REFINERY OF TOMORROW"

Topping units fractionate the crudes into cuts for the various units

by Arch L. Foster

Located less than 30 miles from the Mexican Gulf on a waterway suitable for ocean-going tankers, with pipe lines, railroads, canals and primary highways leading in all directions, the Lake Charles refinery is especially well situated for collection of crude and distribution of products. It includes the best in processes for making the products required by the war and postwar demands.

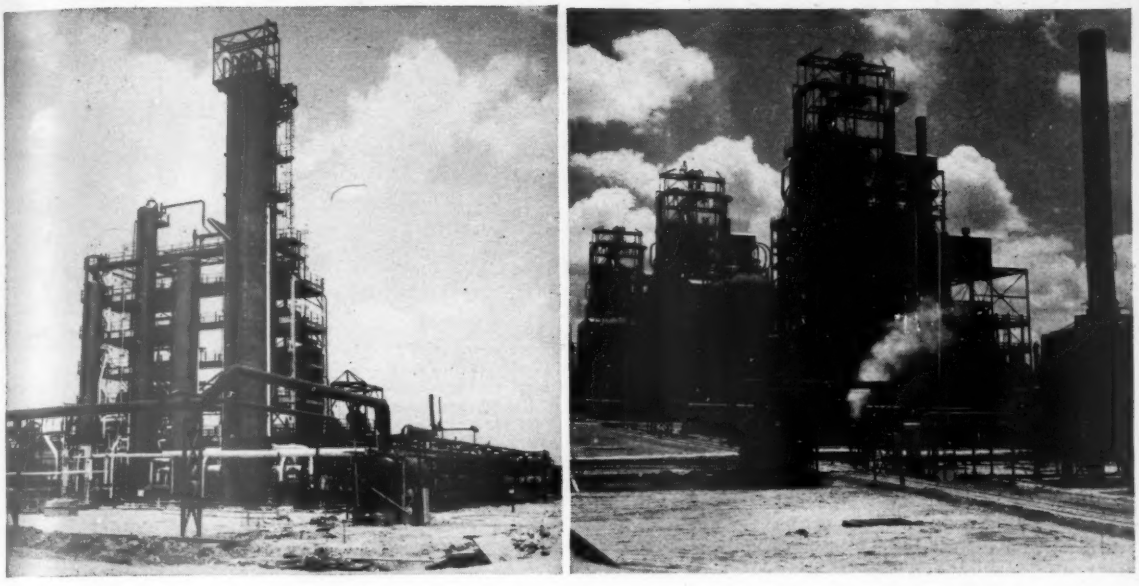
STARTED from "scratch" in a pine forest on an artificial-natural-sea-connected waterway, without old plant installations to tie into the new system, without restrictions engendered by precedent, the newest complete aviation fuel refinery in the world, that of the Cities Service Refining Corp. at Lake Charles, La., was tailor-made to order as the product of a composite dream of a group of refiners old in experience and service. The dream was inspired by study of the prospects for the refinery of the future, and crystallized by the immediate, demanding necessity brought about by war.

The immediate purpose is, of course, the production of war-fuel products in the largest practicable quantities from crude produced within reasonable distances from the refinery. For these purposes it was imperative that the most modern processes be installed, they being indispensable to the production of war fuels of the required characteristics. With no old installations on the site, it was not necessary to consider those and therefore the designers had the enthusing situation for creative building, a clean sheet on which to plan the new plant.

Of necessity there were and are other considerations entering into the deliberations on the design and composition of the new system. Postwar conditions must be studied and the plant must be built with those conditions in mind without, however, detracting from the immediate requirements; i.e., production of the all-important war materials. Many refiners believe the postwar era will bring a gradual and accelerated transition of the conventional refinery and its processing into the practice of a sort of super-refinery technology. New plants should be built in the light of that probability, even though they must first fully meet the emergency requirements. However, future possibilities did not interfere with plans or design considerations, since most technologists believe that the most useful, efficient process making the most efficient product will be in postwar demand as well as at present, albeit may be for the purpose of making products of the same general type but of different qualities for peacetime requirements.

The geographic and economic location of a modern refinery is of far greater importance than in years past, a result of a host of factors all of which affect the position of the plant. The position chosen for this refinery is only 29 miles inland from the Gulf of Mexico coastline, a tanker seaway to world markets. The Calcasieu River is a deep water way, suitable for handling tankers and the intercoastal waterways connect with this river, making barge transport of refinery products, or of

Main refinery office of the company at the plant site



Left: Sulfuric acid alkylation unit "A." Right: Three fluid catalytic cracking units with pipe heater at right

crude to the plant for that matter, a perfectly feasible operation. The refinery is connected by a direct pipe line to Sour Lake in Texas, a distance of some 70 miles, and auxiliary lines connect this system with other main pipe lines, such as the Texas-Empire Pipe Line Co. (Cities Service subsidiary) — Texas - New Mexico and other lines, through which auxiliary crude supplies may be drawn, or from which emergency supplies can be obtained, especially for maintaining war-production schedules. A direct line connects the refinery's finished product tanks with the WEP 20-in. line a few miles north of Beaumont, leading directly to the East Coast. Two major railway lines connect directly with Kansas City; St. Louis and the north; and with New Orleans, 6 hours away; Beaumont; Houston; Galveston; San Antonio and the Central and South Texas country to the westward. The tremendous number of producing fields in all this Gulf Coast-Louisiana-East Texas-Mississippi area, an empire within its own boundaries, insure an adequate supply of crude for an efficient refinery such as this one is. Through the coastal waterway entrance is made simply and efficiently to the Mississippi River system, with water transport throughout the interior of the United States.

In such a position the distribution system for the plant, and the supply systems for raw material—crude oil—is made-to-order and is not dependent on any political or ephemeral human agency. These two systems are of overshadowing importance, without which no plant can succeed. In addition, the plant has plenty of ground space, owning an area of 2,300 acres; and it is within easy reach of an excellent municipality.

Huge Amounts of Material

The amounts of the materials alone used in this refinery—let as a turnkey job to M. W. Kellogg Co. as designers and builders—are staggering, reaching the astronomical values associated only with the huge modern developments of American industry. Some of these outstanding figures are: 385 general process towers and tanks, that is, in addition to temporary or permanent storage; 4,059 control, recording and indicating instruments; 400 tons of catalyst charge to each unit at once, or 1,200 tons in the active system at one time; nearly 800 pumps, ranging from the low power, large-volume water pumps to the high-pressure charge pumps for thermal cracker and reformer units; a total of 25 control boards; 140 oil-storage tanks with a capacity of 5,000,000 bbl. at a time; the enormous total of 114 buildings of all kinds; 2,500,000 linear feet of pipe and more than 6,000,000 ft. of tubes. Many other equally impressive figures are shown in Table 1.

Add to this some of the extraordinary capacities of the plant and its

All commercial means of oil transport are readily available to the refinery

A main street in Maplewood, employe "city" carved out of and built on the site of a pine forest, where more than a thousand homes and apartments are built, with schools, recreation halls, stores, theater, and other accommodations provided

units; 70,000 to 80,000 bbl. of crude charge per day; 40,000 bbl. of charge to the "cat" crackers per day; between $25,000,000 and $30,000,000 paid for labor on the job; a total cost of more than $75,000,000 including the 55,000-ton butadiene plant operated in connection with the refinery and obtaining its raw materials from the latter. Practically all the Calcasieu River water is pumped through the refinery to supply it with cooling water and other requirements, more water than is required by the city of Philadelphia.

Systematic Plant Layout

The refinery proper is laid out in the shape of a large L, with the main units of the plant arranged in succession along the two legs. Auxiliary units, intermediate and some finished products storage tanks are placed within the L, at the shortest distance from both the units from which these products come and the units to which they go for further treatment. The two topping units, breaking the crude into straightrun gasoline, naphtha, gas oils and heavy residual oil, are located at the junction of the two legs. Raw distillates go to the fractionation assembly and thermal reforming units. From the latter, part of the olefins used for the alkylation unit are produced and are returned to the feed preparation units for that process. The gas oils, light and heavy, or combined as one fraction as may be desired at any given time, go direct to the three fluid catalytic-cracking units, "A," "B," and "C," immediately adjacent and occupying the main part of the right-hand leg of the L, for cracking to make once-through aviation base stock from "A" and "B" units, then for further treatment (retreating) in "C" unit to make finished aviation-base stock. These three units are identical in all important items except that operating mostly on light products, cracked distillate, the "C" unit is provided with a lesser light hydrocarbon compressor capacity. "C" unit can be operated on gas-oil charge if and when desired.

The heavy furnace oil is further treated in the deasphalting unit, which is one of the unique operations in the process. Using propane as deasphalting solvent, this heavy residual oil is mixed with appropriate amounts of propane, chilled to the desired temperature, and the heavy asphaltic material, products which are not processable in the catalytic crackers, are dropped out, precipitated and sent to plant fuel or for other purposes for which they may be suitable. The oil remaining in propane solution is depropanized by distillation and forms a maximum yield of heavy gas oil comparatively free from heavy unvaporizable material for virgin charge to the catalytic crackers. By handling this heavy residual fraction in this manner, the plant is planned to provide a maximum percentage of charge to the catalytic-cracking units and thus a maximum yield of motor and aviation fuel components.

Handling Catalytic Distillate

Gases and light hydrocarbons, a so-called "B-B" fraction from the catalytic cracker vapor-recovery system, go to the butadiene plant. This fraction is rich in butylenes from which butadiene is made by catalytic dehydrogenation of the C_4 olefins. The straightrun gasoline and naphthas are sent to the fractionating units where a low-boiling straightrun motor-fuel component is taken overhead and one or more naphtha streams are taken off and reformed to yield a cracked distillate and an olefin stream which is combined with that from the catalytic crackers to go to the butadiene plant or is used in the alkylation operation.

Catalytic distillate is retreated in the "C" unit to complete its conversion into aviation-base stock in the customary manner. Kerosene distillate is treated with clay, and with sulfuric acid if necessary to produce a satisfactory burning oil. Furnace oils may be treated or not, depending on their source and the purpose for which they are sold.

The two alkylation units use the cold-acid process, sulfuric acid as catalyst to combine C_3 and/or C_4 even C_5 olefins with isoparaffins of the same range of molecular weights. The acid is made in the plant in a unit specially designed to manufacture it from sulfur burned in special burners in a contact process now well standardized. The acid, after being used in the alkylation step, is used elsewhere in the plant for treating fractions for various purposes, and is recovered for reuse in the recovery plant.

Adequate Laboratory Facilities

The laboratory is carefully designed to meet the requirements of such a superplant. Additional personnel and equipment are provided for experimental work and for exact control work in fuels and superfuels. Both 1-C and 3-C fuel rating engines are provided, as well as engines for determination of A.S.T.M. and research octane numbers. As to handling finished products, three main docks on the Calcasieu River channel will load seagoing tankers, barges, etc. Pipe lines connect the plant storage with the docks and with loading racks for distribution in every direction and by every conventional means.

By this brief description it may be seen that the location and design of the plant fit it, as far as can now be foreseen, particularly into a place for production of war-necessitated fuels and for postwar peacetime operations. Both these considerations dictated the design and location of the refinery, with the war demands the paramount factor. The combination hookup with the butadiene plant, DPC-owned, and the Firestone-operated synthetic rubber plant alongside simplifies the operation and supply for the latter two units, while giving outlet for a portion of the byproducts of the refining operation.

Three Fluid Catalytic Cracking Units Form the Heart of New Refinery

by G. L. Mateer and J. D. Haney

THREE fluid catalytic-cracking units form the heart of the Cities Service refinery at Lake Charles. Towering into the sky, these giants labor day and night to produce the finest fuel known to modern petroleum science. Finely powdered fluidized catalyst flows in an endless circuit, performing cracking operations on nearly any fraction of crude to produce a wide variety of high quality products.

The catalytic-cracking units process a major portion of the crude and produce, in addition to high quality aviation-base stock, raw materials for all other processing units in the refinery excepting only the crude and straightrun fractionators. In addition to this they supply over 85 per cent of the feed for the 55,000-ton-per-year butadiene plant.

The fluid catalytic-cracking process utilizes the principle that powder when properly aerated with gases or vapors may be made to flow and may be controlled in the same manner as a fluid. In operation the fresh oil feed is injected into a moving fluid stream of hot catalyst and thus heated and vaporized enters the reactor vessel where the cracking reaction takes place. Here the velocity is lowered to a point where the fluid catalyst behaves like a boiling liquid in the vessel, the cracked vapors passing overhead through cyclone separators to the bubble tower and the catalyst being withdrawn from the bottom at a rate which keeps the "boiling fluid" at the desired level. The catalyst, still in fluid form, flows downward through a standpipe and flow controlling slide valve below which it is picked up by a moving stream of preheated air which carries it into the regenerator vessel. Here the carbonaceous deposit formed on the catalyst during cracking is burned by the air stream, the fluid catalyst again acting as a boiling liquid and the flue gases passing overhead through cyclone separators. Leaving the bottom of the separator the catalyst again flows downward through standpipes and slide valves and up into the re-

G. L. MATEER

J. D. HANEY

George L. Mateer was born in Braddock, Pa., and received the bachelor of science and master of science degrees from Penn State College. He joined the technical division of Standard Oil Co. of New Jersey and stayed with that company from 1929 to 1943, spending considerable time abroad. He was made assistant general superintendent of Cities Service Refining Corp. in 1943. He is a member of Phi Kappa Psi and of Phi Lambda Upsilon, the latter an honorary scholastic fraternity in chemistry. He is married and has two sons.

J. D. Haney started life in Philadelphia, joined Cities Service Oil Co., as stillman. He served as still foreman and up to refinery superintendent until 1942, when he joined Cities Service Refining Corp. as superintendent of catalytic cracking and gas recovery. He attended Drexel Institute of Technology, is married and has three sons.

View of topping units, right, and three cracking units, left, showing clearly the complexity of construction

actor vessel having received the fresh oil injection at a point just below the slide valves. Heat liberated in the regenerator vessel in excess of feed vaporizing and cracking requirements is removed by a circulating stream of catalyst which passes through a boiler (generating high-pressure steam) and returns to the regenerator. The flue gases leaving the top of the vessel are cooled and "conditioned" and pass through a Cottrell precipitator to the stack. The precipitator serves to remove the small amount of catalyst which remains in the flue gas after leaving the cyclones and which is subsequently returned to the system from hoppers below the precipitation equipment.

Flow of Products

Cracked oil vapors entering the bubble tower are separated into three distillate fractions and a bottoms product. The bottoms fraction is continuously circulated through an exchanger and a high-pressure steam boiler and returned to the top of the "scrubber" section of the tower. This recirculation serves two purposes: (1) It desuperheats the entering vapors to the desired temperature for fractionation and (2) it scrubs out entrained catalyst particles which have been carried through the cyclones at the top of the reactor. This entrained catalyst is fed back to the reactor by returning an equilibrium portion of this "slurry oil" stream.

Overhead distillate from the bubble tower may be cut to any desired end point (e.g. 340° F. when producing aviation-base stock or 400° F. for motor-fuel operation). The upper side stream may be varied over a considerable range taking a narrow cut naphtha, furnace oil base or wide cut cycle gas oil as desired. The lower side-stream product will be material boiling between whatever is withdrawn at the upper side stream and the bottoms. Both side stream drawoffs are equipped with steam strippers.

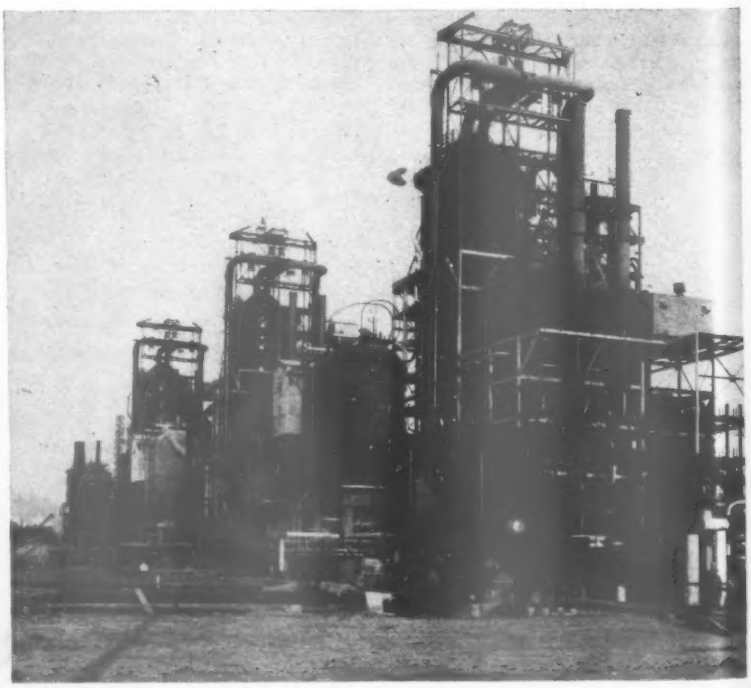
The overhead from the tower passes through a condenser to a reflux drum from the bottom of which the tower-top reflux and the distillate product are drawn. Overhead gases from the reflux drum flow to a dry drum from which compressors take suction, compressing the gas up to 60-70 lb. for the recovery unit.

The three fluid cracking units have been designated on the accompanying flow diagram, Fig. 1, as A, B, and C. The A and B units are identical and the C unit differs from them only in the amount of light hydrocarbon compression capacity. Since the normal operation of the C unit produces relatively small amounts of gases less compressor capacity is required.

The A and B units normally process total crude above 350° F. except for kerosene requirements and the salt and asphalt. The salt and asphalt will vary from 2-10 per cent and average about 6 per cent on crude. The width of the crude fraction charged to catalytic cracking is so great as to make possible extremely high yields per barrel of crude processed. Since the gas oil is available in two separate cuts, light and heavy, they are cracked separately each under its most favorable conditions. The A and B units are run to produce a maximum quantity of normal butylenes (for butadiene plant feed) and C_5-475° F. fraction (Unit C retreat feed). The cracking intensity required to produce maximum butylene yields is substantially lower than when operating to produce once-through aviation-base stock. This allows the A and B units to process a larger quantity of gas oil when running the former operation. The C_5-475° F. fraction from this low intensity operation is retreated (catalytically recracked) in the C unit to produce a high yield of superior quality aviation-base stock. Typical yield and product inspection data for these operations are shown in Table A and Table B.

Each unit may replace any other unit in its operation during a turnaround. For instance A and B units when on stream may store material for retreating which then may be run on any of the three units since A and B can retreat gasoline as well as run either grade of gas oil. The C unit can also run selected gas oils once-through (for aviation-base stock production) alone or blended with normal retreat feed. The carbon production when running the retreating operation is considerably lower than when running gas oils or blends and the unit therefore has available excess regeneration capacity during this operation.

Since the slurry oil stream, which is usually recycled to the reactor to return entrained catalyst, is generally quite refractory diverting this material from the reactor allows a considerable increase in fresh-feed rate. Provision has therefore been made to return the slurry oil from the A or B unit or both to the C unit reactor, thus increasing the feed capacity of A and B units while at the same time increasing the carbon production on the C unit. This increased carbon production, although not necessary, is desirable from a standpoint of heat balance and steam production. Connections have also been installed between the precipitator hoppers of the three units so that "catalyst fines" may be intertransferred. This system may be used for three purposes: (1) To correct for fines which have been transferred with the slurry oil; (2) to increase catalyst particle size in any one unit for the purpose of obtaining higher reactor catalyst density and therefore greater cracking intensity and (3) for controlling the catalyst activity so as to maintain a desired level of activity in each unit. Catalyst losses would ordinarily be re-



"A," "B" and "C" catalytic cracking units

placed continuously with fresh catalyst on each unit. The average activity of the catalyst in any unit is a function of the replacement rate. With the catalyst-transfer system all catalyst additions may be made at the unit requiring the highest activity level. Activity level control assures optimum operation on each unit.

Catalytic Gas Recovery and Fractionating Unit

The catalytic gas recovery and fractionation unit handles all of the bubble-tower overhead products from the three catalytic-cracking units. The overhead products are normally divided into the following fractions: (1) Dry gas (C_2 and lighter); (2) butane-butylene fraction; (3) C_5-150° F. fraction; (4) 150°-475° F. retreat charge, and (5) C_5-340° F. stabilized aviation-base stock.

The equipment consists of an absorber and lean-oil still, splitter tower, depropanizer, debutanizer and retreat fractionator, operating normally as shown in the simplified flow diagram Fig. 1.

Normal Operation

The gases and liquids from A and B units enter the recovery unit at 60-75-lb. pressure. They are cooled and recontacted in a high-pressure flash drum. The overhead from this drum passes directly to the absorber which is operated with ammonia refrigerated lean oil to achieve 100 per cent recovery of butanes. The rich oil from the absorber is pumped through a fired preheater to the lean-oil still. The still overhead and the feed flash-drum bottoms then enter the splitter tower which takes overhead isohexanes and lighter, splitting the gasoline in the middle of the C_6 fraction. Excellent fractionation is obtained on this tower, a gap of 30°-40° F. between overhead end point and bottoms initial boiling point being usually obtained. The bottoms from the splitter (150°-475° F.) normally forms the major component of the feed to the retreating operation on Unit C. Overhead from the splitter tower consisting of I-C_5 and lighter passes to the depropanizer where C_3 and lighter is taken overhead and joins the absorber dry gas going to the refinery fuel-gas system. The bottoms consisting of butanes and C_5-150° F. material is fractionated in the debutanizer to produce butane-butylene fraction (overhead) and C_5-150° F. (bottoms). These two fractions, after removal of the n-butylenes at the butadiene plant, make up the feeds to the butene and pentene alkylation units.

Overhead from Unit C cut to 340° F. end point on the unit fractionator also enters the recovery unit at 60-70 lb. This material is recontacted, cooled and enters a separate feed flash drum the overhead of which joins the gas stream entering the absorber tower. The feed flash drum bottoms stream goes to the retreat fractionator which produces a butane-free 340° F. end point aviation-base stock from the bottom, the overhead (C_4 and lighter) going to the absorber and thus being recovered along with the light hydrocarbons from Units A and B.

Several features have been incorporated in this unit which make for flexibility of operation, sharpness of

TABLE A—NORMAL OPERATION WITH SYNTHETIC CATALYST
PRODUCT YIELDS

Feed stock—	350°-640° light mixed gas oil	640° heavy mixed gas oil	150°-475° cracked gasoline
Type operation	Max. butylene	Max. butylene	Retreat
Reaction temperature, °F.	935	945	875
Fresh feed, BPCD	20,500	16,620	14,680
Slurry oil, BPCD	500	.....	2,200
Total feed, BPCD	21,000	16,620	16,880
Product yields, per cent:			
Butylenes, volume	7.0	10.7	2.3
Isobutane, volume	6.4	6.9	4.0
n-Butane, volume	0.9	1.5	0.7
C_5-150° F., volume	11.5	16.7	...
Aviation-base stock, volume	...	...	48.1
150°-475° F., volume	36.7	29.8	...
340°-400° F., motor naphtha, volume	...	...	12.9
Light cycle gas oil	29.1	13.5	20.0
Heavy cycle gas oil, volume	1.9	14.9	...
C_3 and lighter, weight	9.5	12.8	6.9
Coke, weight	4.1	6.3	6.7

TABLE B—NORMAL OPERATION WITH SYNTHETIC CATALYST
PRODUCT QUALITY

Feed or product—	Light G.O. feed	Heavy G.O. feed	Retreat feed	Aviation base	Motor naphtha	Analysis of C_3 and lighter
A.P.I.	37.6	26.4	41.5	46.0	39.5	Mol (per cent)
A.S.T.M. distillation:						
I.B.P.	380	525	175	126	360	H_2 12.6
10 per cent	454	698	239	190	366	CH_4 9.9
30	504	750	293	232	369	C_2H_4 8.7
50	545	790	354	263	373	C_2H_6 10.1
70	579	880	400	288	378	C_3H_6 40.9
90	619	1,040	446	308	392	C_3H_8 17.8
End point	648	....	488	335	420	Total 100.0
Aniline point, °F.	168	200	...	20	88	
A.S.T.M. pour (max.), °F.	10	100	...	...	...	
W. & N. char. factor	11.8	11.9	...	...	...	
Octane No., A.S.T.M. (clear)	...	...	...	82.6	56	
Octane No. 1C + 4.6 cc. TEL/gal.	...	...	...	94.5	...	
Octane No. 3C + 4.6 cc. TEL/gal.	...	...	...	S+3.5	...	
R.V.P.	...	...	...	3.0	...	
1C + 4.6 cc. blended to 7 lb. RVP with isopentane (95% purity)	...	...	...	98.0	...	
Vol. % C_4 alkylate req. in 100-oct. blend	...	...	...	20.0	...	

*Calculated from 10 mm. distillation.

TABLE C—ALTERNATE OPERATIONS WITH SYNTHETIC CATALYST
PRODUCT YIELDS

Feed stock—	Light coastal gas oil	Wide-cut paraffinic gas oil
Operation	Once through aviation base	Motor gasoline operation
Reaction temperature, °F.	925	910
Fresh oil feed, BPD	15,500	18,000
Yields based on gas-oil charge (per cent):		
Butylenes, volume	4.5	6.2
Isobutane, volume	10.5	3.7
n-Butane, volume	2.7	1.1
C_5 free 340° e.p. aviation base, volume	30.5	...
C_5 free 400° e.p. motor gasoline, volume	...	45.0
340°-400° F. naphtha, volume	7.5	...
Light cycle gas oil, volume	30.0	30.0
Heavy cycle gas oil	5.0	12.0
Dry gas, weight	11.2	6.5
Coke, weight	6.0	5.5

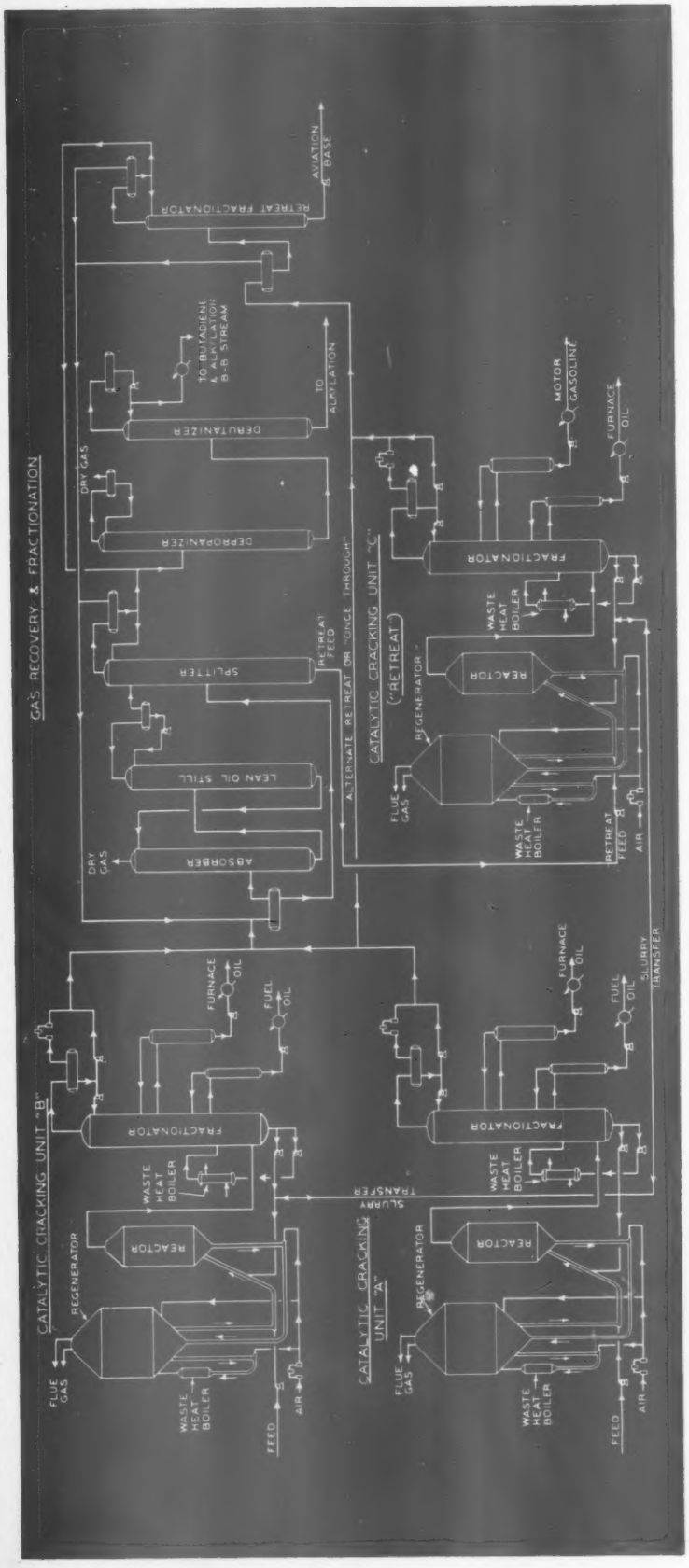


Fig. 1: Flow chart of catalytic cracking, retreating, and fractionating sections of Cities Service's Lake Charles refinery

control and low maintenance costs. The lean-oil still and splitter tower each have separate gas-fired preheaters and reboilers. The only pressure controls are on the absorber overhead and the retreat fractionator overhead. The debutanizer overhead product flow control is set from a relay on the feed flow and the temperature on the ninth tray. This arrangement assures substantially 100 per cent recovery of the butane-butylene fraction under varying conditions of quantity and composition.

The versatility of the recovery and fractionation unit is such that any two dissimilar operations performed simultaneously on the catalytic-cracking units can be simply and adequately handled. For example, one unit may make motor gasoline (400° e.p.) while the other two make once-through aviation-base stock (340° e.p.). The motor gasoline, cut to end point on its unit fractionator, can be stabilized in the retreat fractionator while the aviation distillate is handled in the retreat feed-preparation section. The splitter bottoms will then be C_5-340° F. aviation-base stock, the cut being made between C_5 and C_6 fractions. The splitter overhead and the stabilizer overhead may be separated into C_3 and lighter, B-B, and total C_4.

The products from catalytic cracking are used as follows: (1) The absorber dry gas and the depropanizer overhead are sent to the refinery fuel-gas system; (2) the B-B fraction, including the B-B from the reforming unit, is sent directly to the butadiene plant where the normal butylenes are removed and the isobutylene and saturates are returned to the C_4 alkylation unit; (3) The C_5-150° F. fraction is alkylated with isobutane to produce C_5-C_6 alkylate and saturates. This product is a component of 100-octane aviation gasoline; (4) the 150°-475° F. material from the bottom of the splitter tower is a major part of the feed to retreating (Unit C); (5) the C_5-340° F. from the bottom of the retreat fractionator at the recovery unit requires only caustic washing before being blended into 100-octane aviation gasoline; (6) light cycle gas oils from Units A and B bubble towers are blended with virgin heavy naphtha to make No. 2 furnace oil; (7) heavy cycle gas oils from A, B and C units are fed to the thermal unit for pour-depressing or are blended with asphalt to make No. 6 fuel oil; (8) heavy naphtha from Unit C (upper sidestream drawoff) is a component of motor gasoline or is recycled back to the Unit C reactor.

Table E shows a few of the operations which may be run with natural (clay) catalyst. It seems likely that in the postwar period sufficient

demand for aviation fuel will exist to keep one catalytic-cracking unit on some type of aviation operation full or part time. This will probably mean keeping synthetic catalyst in one unit. It seems fairly probable that new, more efficient and cheaper synthetic catalysts will be developed so that it may be advantageous to use them for normal motor-gasoline operations.

The clay catalyst, however, offers some interesting methods of motor-gasoline production. Of special interest is running a reduced crude. The operation shown in Table E on 50 per cent East Texas reduced crude is entirely practicable providing the salt content of the reduced crude is kept down to a point where its effect on the catalyst is not pronounced. The cycle gas oil produced when cracking reduced crude is a distillate oil the lighter portion of which may be blended into No. 2 fuel and the heavy portion of which make an excellent charge stock for thermal cracking.

Qualities of Products

The feasibility of the reduced-crude operation suggests that selected entire crudes may be charged directly as feed to the catalytic-cracking units. However, commitments for straightrun products will probably limit the amount of crude processed in this manner.

Available data indicate that a considerable quantity of material may be recycled to produce higher yields of motor gasoline of equal quality. This operation offers an attractive means of conserving crude since very little fuel oil would be produced.

The B-B produced in the motor-gasoline operations although smaller in quantity is richer in unsaturates so that gasoline vapor pressure may be adequately controlled by alkylation or catalytic polymerization.

The octane numbers of the motor gasolines are 79-82 motor method and 92-95 research method. An overall motor-gasoline blend from all refinery operations would contain a major portion of this material and will consequently have excellent antiknock characteristics.

In view of the trend toward the use of petroleum products as raw materials in the manufacture of organic chemicals, it is interesting to note that considerable quantities of ethylene and propylene are produced. Approximately 75,000 lb. of ethylene and 300,000 lb. of propylene will be produced per day when operating for motor gasoline. Recovery of these hydrocarbons would provide raw material for the manufacture of a wide variety of chemical products used for solvents, plastics and pharmaceuticals or in the synthesis of more complex organic compounds.

TABLE D—ALTERNATE OPERATIONS WITH SYNTHETIC CATALYST PRODUCT QUALITY

	Light coastal gas oil feed	Wide-cut paraffinic gas oil feed	Aviation base C_5-340° F. coastal gas oil	Motor gasoline from wide cut gas oil
A.P.I. gravity	28.5	31.0	54.6	58.8
A.S.T.M. distillation:				
I.B.P., °F.	470	460	120	110
10 per cent	513	550	145	135
30	533	618	162	161
50	546	677	215	210
70	562	718	264	279
90	590	736	295	352
End point	634	...	334	402
R.V.P.	...	...	7.1	5.7
Octane No. A.S.T.M. (clear)	...	...	...	82.0
Oct. No. 1C + 4.6 cc. TEL/gal.	...	...	94.0	...
Oct. No. 3C + 4.6 cc. TEL/gal.	...	...	S2.5	...
Aniline point, °F.	140	198	50	75
W. & N. char. factor	11.3	11.9	...	...
A.S.T.M. pour, (max.), °F.	0	90	...	...
Octane No. CFR-R (clear)	...	...	...	95.2

TABLE E—CATALYTIC CRACKING OPERATIONS WITH NATURAL (CLAY) CATALYST—PRODUCT YIELDS AND INSPECTIONS

Feed stock—	Paraffinic wide-cut gas oil	Paraffinic light gas oil	East Texas 50 per cent reduced crude	Coastal heavy gas oil
Operation No.	7	8 A	9	10
Operation	Mot. gaso.	Mot. gaso.	Mot. gaso.	Mot. gaso.
Feed-rate, BPD	20,000	21,500	16,000	22,000
Temperature, °F.	910	875	980	930
Yields, per cent on feed:				
10 lb. R.V.P., 400° E.P. gasoline, vol.	48.0	42.5	43.3	50.0
Excess butanes, vol.	7.6	11.5	7.5	6.0
No. 2 fuel oil, vol.	31.0	39.0	28.0	29.0
Heavy cycle gas oil, vol.	10.0	5.0	17.0	12.5
Dry gas (C_2 and lighter), weight	6.6	8.8	6.4	8.4
Coke, weight	5.7	5.0	6.6	4.2
Feed stock:				
A.P.I. gravity	31.0	33.5	25.5	22.0
A.S.T.M. distillation:	(*)		(*)	(*)
I.B.P.	450	480	480	478
10 per cent	540	556	575	570
30	624	580	666	632
50	681	601	766	702
70	742	625	890	787
90	861	659	...	894
End point	965	700	...	972
Gasoline, (400° E.P.):				
A.P.I. gravity	60.0	61.0	58.5	57.0
A.S.T.M. distillation (per cent):				
I.B.P.	99	94	99	101
At 140°	14.5	25.0	17.0	13.0
At 158°	22.0	35.5	24.0	20.0
At 212°	43.0	56.0	45.5	40.0
At 257°	59.0	68.0	61.0	57.0
At 284°	68.0	84.5	69.5	68.0
At 356°	89.8	92.0	89.5	91.0
R.V.P.	9.9	10.0	10.1	10.0
CFR-M (clear)	80.5	81.3	79.1	80.5
CFR-F (clear)	92.0	94.0	93.8	92.9
C_3 and lighter, mol per cent:				
H_2	12.0	8.0	23.0	12.0
CH_4	30.0	11.0	23.0	34.0
C_2H_4	10.0	10.0	7.0	7.0
C_2H_6	19.0	26.0	13.0	14.0
C_3H_6	22.0	35.0	24.0	22.0
C_3H_8	9.0	10.0	10.0	11.0
Total	100.0	100.0	100.0	100.0

*Calculated from 10 mm. distillation.

TABLE F—TYPICAL FURNACE OIL FRACTIONS*

Feed stock	Paraffinic wide-cut gas oil	Paraffinic light gas oil	Paraffinic wide-cut gas oil	Paraffinic light gas oil
Catalyst	Synthetic	Synthetic	Natural	Natural
No. 2 fuel oil product:				
Gravity, °A.P.I.	32.4	35.6	31.2	31.0
A.S.T.M. distillation:				
I.B.P.	470	487	463	450
10 per cent	509	521	492	488
30	525	534	514	505
50	537	546	537	525
70	560	562	562	548
90	593	591	595	583
End point	625	620	625	624
Conradson carbon (10 per cent bot.)	0.09	0.07	0.05	0.07
Color (R)	...	...	20	20
Aniline point, °F.	...	...	136	133
Flash, °F.	238	240	225	225
A.S.T.M. pour (max.), °F.	10	20	15	15
S.S.U. vis. at 100° F., sec.	35.2	35.0	37.0	35.5

*These fractions are as produced. They are blended with virgin heavy naphtha to meet front-end volatility requirements.

View showing two alkylation units: left, light oil; right, fractionators

Alkylation and Isomerization Facilities For 9,500 Barrels Per Day Are Provided

by Frank Poole and G. H. Branscombe

ALKYLATION-isomerization facilities at Lake Charles include a 2,000 plus bbl.-per-day butene alkylation unit, a 6,000 plus bbl.-per-day pentene alkylation unit, and a 1,500 plus bbl.-per-day butane isomerization unit. These units operate in conjunction with one another even to a greater extent than in most refineries — common towers serving all three units.

Feed stocks for the butene unit originate in the after-fractionation sections of the cracking and topping units. The cracked stock containing normal and isobutane, all of the butylenes and some propane and pentane contaminants, is treated for sulfur removal and further processed in the butadiene plant. Processing at the butadiene plant besides removing most of the normal butylenes from the feed for butadiene production, converts isobutylene to a dimer, so that the feed stock upon returning to pressure storage tanks in the basic refinery contains normal and isobutane, traces of normal butylenes, di-isobutylene and some pentanes. The straightrun stock containing primarily normal and isobutane is treated and stored for feed to the unit. The cracked feed stock along with the isobutane recycle stream from the depropanizer bottoms, after being cooled in the feed precooler and reactor feed vs. effluent exchangers, is charged to the four reactors which operate in parallel (See flow sheet.)

The reactors are each divided into three sections: a reaction section, an acid settling section and a final zone which provides holding time for the effluent hydrocarbons. In the reaction section the feed is intimately mixed with sulfuric acid by circulating the hydrocarbon and acid with pumps at high velocity through a number of glass-dispersion jets. This circulating action forms an emulsion, and while in intimate contact in this emulsified state, alkylate is formed by the reaction of isobutane and the unsaturates in the feed. Contact time is approximately ½ hour. Partial settling of the hydrocarbons takes place in the upper layer of the reaction zone and the incompletely settled mixture flows over a weir into the acid settling section from which part of the acid is recycled to the reaction zone and the remainder is drawn off to spent-acid storage for use in the pentene alkylation unit. The hydrocarbons from the acid settling section including unreacted isobutane, normal butane, alkylate and any contaminants flow over a second weir into the final holding section.

Alkylation Operating Conditions

Reactor temperature is maintained at about 35° F. by an auto refrigeration system. The hydrocarbons are permitted to vaporize at their vapor pressure corresponding to the desired temperature of reaction. The vapor, rich in isobutane, is picked up by 600-hp. gas-engine-driven compressors, (one compressor to a reactor) water cooled, condensed and returned to the reactors. The proper acid strength in the reactors is maintained by a supply of

FRANK POOLE

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G. H. Branscombe was born and educated in Canada, graduating from University of Saskatchewan with the bachelor of science degree in 1922. He joined the oil industry in 1925, and with M. W. Kellogg Co. has helped to design and build refining plants and units in Iran, Japan, France, Canada and throughout the U.S.A.

G. H. BRANSCOMBE

fresh 98 per cent white acid from the acid plant within the refinery.

The settled hydrocarbons from the holding section of the reactors are pumped through the reactor feed vs. reactor effluent exchangers to the caustic-wash drum and water-wash drum. These drums permit treatment of the effluent with dilute caustic and water for removal of traces of acid in the reactor product. The hydrocarbon stream from the water wash drums is joined by the straightrun butane feed, preheated and fed to the isobutane tower or deisobutanizer. The straightrun butane feed contains no unsaturates so it is charged directly to the isobutane tower to recover the isobutane it contains for alkylation, and the normal butane for isomerization.

In the isobutane tower, propane, isobutane and some normal butane are taken overhead and the remainder of the normal butane and alkylate, along with any pentanes, are removed as tower bottoms. The overhead product is preheated and charged to the depropanizer. In the depropanizer, propane equal to that brought in as a contaminant and formed by side reactions within the units is removed as an overhead product and pumped to the desalting unit for use as a solvent. Enough of the depropanizer-bottoms product, primarily isobutane, to maintain at least a 5 to 1 isobutane-to-unsaturate ratio in the reactor feed is recycled to the butane alkylation reactors and since feed stocks to the butene alkylation unit contain an excess of isobutane, the remainder of the bottoms is fed to the pentene reactors. This is one of the tieins among the three units.

Pentene Alkylation

The bottom product from the isobutane tower is fed under its own pressure to the debutanizer where substantially pure normal butane is taken to storage as the overhead product for feed to the isomerization unit, and full boiling range alkylate is taken as a bottoms stream. The total alkylate is further fractionated in the rerun tower into an overhead product suitable for blending into aviation gasoline and a heavy alkylate which is used for motor gasoline blending.

The pentene alkylation unit is similar to the butene unit, except that it has five reactors operating in parallel instead of four and has only a two-tower distillation system, a debutanizer and rerun tower. Depropanizing and denormal butanizing of the pentene reactor effluent is carried out by transferring a purge stream containing propane, isobutane and normal butane to the isobutane tower of the butene unit. Propane is removed from this stream as depropanizer overhead; the isobutane is recycled to the pentene reactors from the depropanizer bottoms and the normal butane is removed in the debutanizer overhead stream.

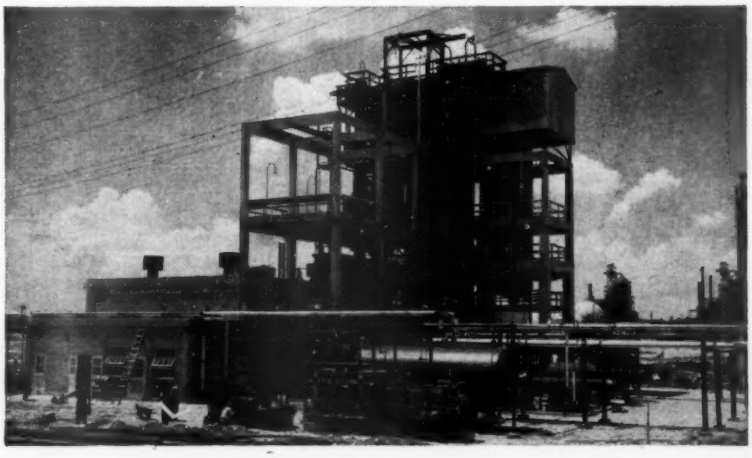
Clark compressors operating on light refinery vapors

Unsaturated feed for the pentene unit is obtained by making a C_5-to-150° F. cut of the catalytic-cracker product. This material, containing about 50 per cent of unsaturates and rich in isopentane, is treated and stored. Alkylation avoids the catalytic retreating of this cut. The excess isobutane returned from the butadiene plant in the butane-butene cut is not sufficient to alkylate the total C_5-to-150° F. product, so butane isomerization facilities have been installed to make up for this deficiency of isobutane.

The C_5-to-150° F. feed is pumped from its storage spheres, joins the isobutane recycle and makeup isobutane from the butene unit and the recycle from the debutanizer overhead from the pentene unit, passes through feed coolers and exchangers into the reactors in exactly the same way as in the butene unit.

The five pentene reactors are identical with the butene reactors and they operate in a similar manner. The acid, emulsion and refrigerant are circulated as previously described for the butene unit and reactor temperature is maintained in an identical manner. The proper acid strength in the reactors is maintained by a supply of spent acid from the butene unit. In other words acid runs in series through the two units. Fresh 98 per cent acid is supplied only to the butene unit.

From the reactors, the settled hydrocarbons pass through caustic and water-wash treatment similar to that on the butene unit. After preheating they are charged to a debutanizer. The split in this tower is between normal butane and isopentane—normal butane and lighter being taken off as an overhead product and isopentane and alkylate as a bottoms product. The so-called purge stream for ridding the pentene unit of propane and normal butane is part of the overhead product on this tower, and is pumped as feed to the isobutane tower of the butene unit; this stream is regulated to carry propane and normal butane away from the pentene unit at a rate equal to that



Isomerization unit for converting normal to isoparaffins

at which these contaminants are brought in with the feed. The remainder of the overhead product is recycled back to the reactors.

The bottoms product from the debutanizer is fed to the rerun tower where isopentanes, isohexanes, and that portion of the true alkylate falling in the aviation gasoline boiling range is taken overhead, and heavy alkylate is removed as a bottom product.

In order to make up for a deficiency of isobutane in the plant it is necessary to isomerize normal butane. Feed stock for this unit is furnished as a debutanizer overhead product on the butene-alkylation unit. The unit is of vapor-phase type employing a fixed bed of aluminum-chloride catalyst supported on Porocel. Anhydrous hydrogen chloride, acting as a promoter, is passed through the bed. The feed stock normally dry, is run through regenerative type driers to protect the catalyst from possible slugs of entrained water, preheated and fed through the catalyst bed. Proper temperature, pressure and hydrogen chloride concentration control conversion, at the desired level. The product from the converter is condensed and pumped to the hydrogen chloride stripper where a gaseous mixture of hydrocarbons and hydrogen chloride is taken as an overhead product and recycled to the converters. Isobutane, unconverted normal butane, some propane and pentane formed from side reactions within the converters are taken as a bottoms product. To remove traces of hydrogen chloride the bottoms product is washed with caustic and water before returning it to the isobutane tower of the butene-alkylation unit for fractionation.

Means for reactivating the catalyst in situ have been provided, and good catalyst life can therefore be expected.

The butene-alkylation unit is the heart of alkylation-isomerization facilities at Lake Charles. This unit is already in operation, and has operated consistently, well above design capacity. Acid consumption including original reactor inventories is already below 0.75 lb. per gallon of alkylate produced. While acid consumption in the long run will not be important, acid from the acid plant within the refinery being available in large quantities at low lost—ultimate acid consumption on the butene unit will be less than ½ lb. per gallon.

The isobutane tower or deisobutanizer has regularly produced an overhead product containing over 90 per cent isobutane with only negligible amounts of isobutane in the bottoms product.

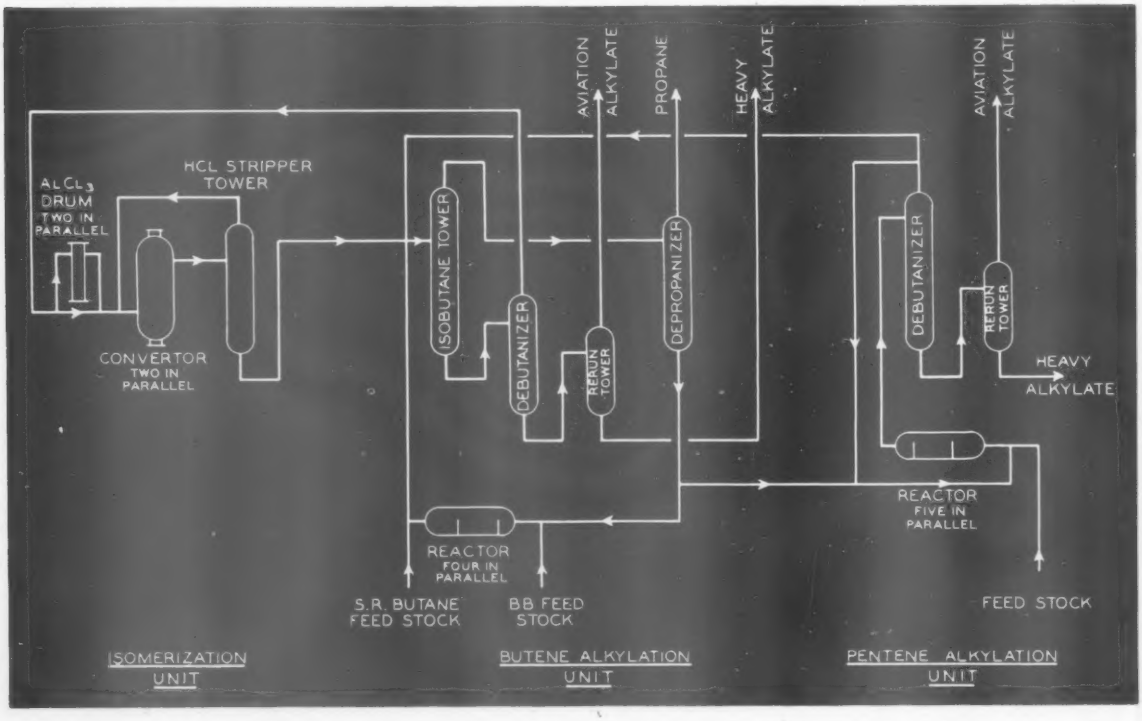
A suitable isomerization feed stock has been produced as debutanizer overhead on this unit while making vapor pressure and distillation requirements on the aviation alkylate product.

The horizontal jet type reactors, a feature of most Kellogg units, have proven that they can compete favorably with other commercial type contactors. Product quality has been good from the beginning of operations even while operating above design capacity on the reactors.

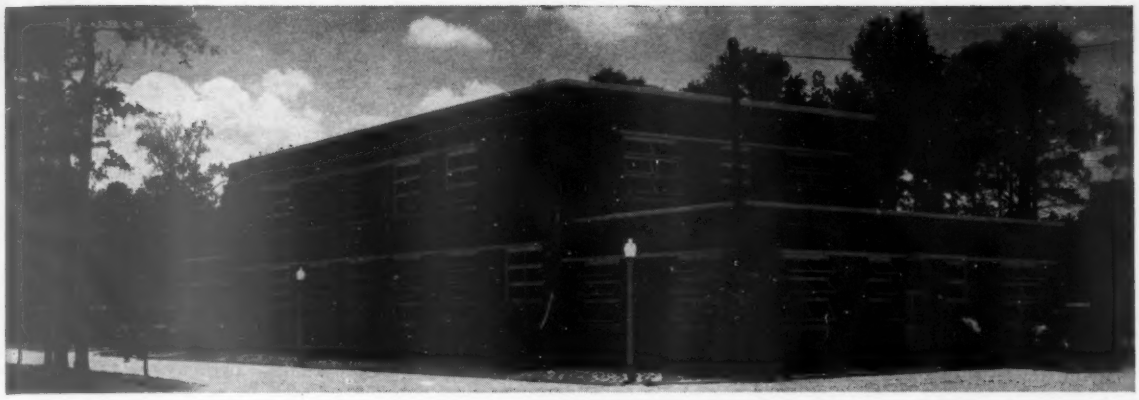
The pentene unit, especially in the reaction section, follows closely the design of the butene unit. The distillation system is simple. No particular trouble is anticipated in the operation of this unit. Higher acid consumption than on the butene unit is expected, but the acid plant will be able to handle this load easily. The octane number of the alkylate produced from this unit will, of course, be lower than the premium stock made on the butene unit, but it will nevertheless be a satisfactory aviation gasoline blending material.

The isomerization unit has not operated as yet, but one of the most important factors in the operation of such a unit, preparation of good feed stock, has already been accomplished. Both fresh and spent catalyst can be handled in large quantities with minimum trouble. The fresh catalyst is put into the unit with a bucket-type conveyor while the converters are set at an elevation which makes it possible to dump an entire batch of spent catalyst into a gondola type wooden railroad car.

Equipment within this unit is specially designed to operate while handling the corrosive catalyst, and a good service factor for this type of unit should be attained.



Flow chart of alkylation and isomerization units at the Tutwiler Lake Charles refinery



Chemical laboratory in the basic refinery where all control, analytical, and experimental work is centered

Chemical Laboratory Equipped for Control And Experimental Operations

by W. W. Scheumann and J. W. Griswold

THE testing laboratories and experimental facilities of the Cities Service Refining Corp. at Lake Charles consist of the basic refinery laboratories, butadiene laboratories and the pilot plant facilities.

These laboratories provide facilities for plant control, experimental and research work. They are housed in a two-story, modern brick building, 178 ft. in length, 54 ft. in width, with approximately 15,000 sq. ft. of floor space. In the design of the building, special consideration was given to ventilation and air conditioning, lighting, availability of utilities, and other features which facilitate laboratory operations.

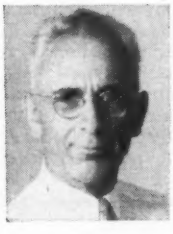
On the first floor are the offices for the head of the laboratories, general administrative offices, library and conference room. The plant control laboratories are also on this floor and consist of two physical testing laboratories, three chemical laboratories, the gas and hydrocarbon analysis laboratory, the engine laboratory and an experimental laboratory. Stock rooms are also provided for various laboratory supplies and chemical reagents. A fireproof vault for storage of samples completes this floor.

The second floor is allocated to research and development work, and provides three large laboratories, three smaller laboratories, as well as additional office space for research chemists and an additional stock room for special research supplies.

The physical testing laboratory is equipped with the most modern type of units and apparatus for the determination of physical constants on petroleum fractions from the various units in the plant. In spite of newer developments in refining, physical testing continues to be one of the major requirements in refinery laboratory work, and setting up the equipment for these laboratories and the necessity for turning out work of this type in large volume for refinery control purposes is stressed.

Because of the many catalytic processes in the plant, equipment which is not required in the usual refinery laboratory is necessary at Lake Charles. An interesting example of such equipment is the apparatus for determining the particle size of cracking catalyst by means of air elutrition. The extreme fineness of the catalyst used in the fluid process renders the established methods for classifying particle sizes of solids inoperative, and a special method which floats particles of given particle size in a stream of air is used in classifying catalyst of this type.

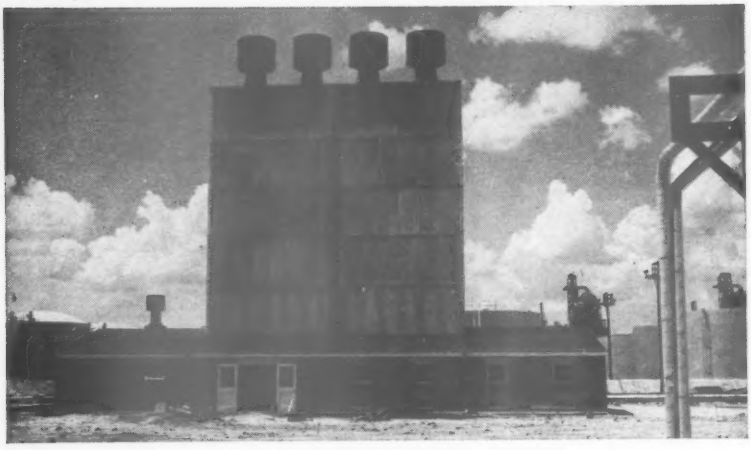
The general chemical laboratory plays a very important part in refinery control. The work carried out covers water analysis, control of treating operations, control of sulfuric-acid manufacture, catalyst-regeneration control and other items. In addition, a more familiar type of work such as the determination of sulfur in petroleum products, salt in crude oil, tetraethyl lead in gasoline and items of this kind are also



W. W. SCHEUMANN *J. W. GRISWOLD*

W. W. Scheumann was granted the bachelor's degree in chemical engineering at Purdue University, then worked 2 years for Aluminum Co. of America. Joining Cities Service in 1925 as analytical chemist, he became chief chemist of Cities Service Refining Co. in 1926, then chief chemist of Cities Service Oil Co. of Delaware from 1931 to 1941. Then made general superintendent of the refining division, he retained that position until joining the refining corporation in 1943.

J. W. Griswold, foreman of the pilot plant, was born in Wisconsin, attended University of Wisconsin and later was employed by Cities Service. He has had wide experience both in plant operation and in research experimental work, always with Cities Service, except for a year when he was loaned to the Office of Petroleum Administration for War.



Pilot plant where small research results are translated into larger-scale operations

determined. A special laboratory has been set up to work principally on control of oxidation stability of aviation gasoline with equipment for the determination of the A.S.T.M. gum, induction periods, Army Air Force gum determinations, copper dish gum determinations and other stability tests. The amount of work of a strictly chemical nature as contrasted to physical testing is a major factor in the control of the Lake Charles refinery. Equipment includes some of the most modern of analytical tools to enable chemists to carry out their work speedily and accurately. Included are electric titrimeters and pH measuring devices, magnetically damped analytical balances, carbon combustion trains, colorimeters, for both gaseous and liquid hydrocarbons and similar items.

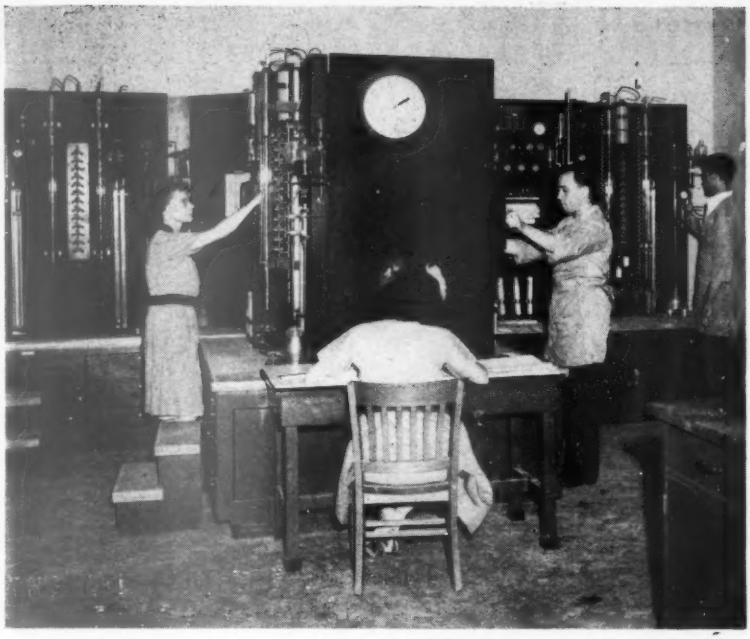
Gas analysis and hydrocarbon separations play a vital part in the control of catalytic cracking, alkylation, isomerization and precise fractional distillation. The gas analysis laboratory is, therefore, a particularly important part of plant control. Both chemical and physical methods of gas analysis are used. The laboratory is equipped with four Hyd-Robot low-temperature fractional distillation units. Fractions from these units are further analyzed chemically by hydrogenation, bromide and sulfuric-acid absorption or with anhydrous hydrogen chloride equipment. The infra-red spectrophotometer is used both in conjunction with the fractional distillation equipment for further analysis of fractions and as a primary means of analysis of samples where qualitative results are known and quantitative information required.

The engine laboratory is equipped with A.S.T.M. motor method and research method engines, an A.S.T.M. diesel fuel engine, and both the 1-C and 3-C aviation-fuel engines. In designing this laboratory special precautions were taken to soundproof it. The walls are insulated with 2 in. of mineral wool, covered with Celotex board; all air ducts are lined with acoustic tile; all doors are insulated; and double windows are installed. Each engine is mounted on an insulated pier so as to minimize vibration.

The experimental laboratories are equipped with a true boiling point distillation unit for evaluation of crude oil and other stocks. Numerous other distillation units have been erected for assay distillations of various types. Included also are facilities for experimental treating and blending of products and conducting other refinery operations on an experimental scale.

In order to handle the large number of samples which pass through the control laboratory each day, all sampling and routing of samples in the laboratory is handled in accordance with a definite sampling schedule. Samples are routed to various sections depending upon the analysis or tests to be made and results returned to a central dispatching point. From this point results are

Left: Analyzing gas by infrared spectrometry. Right: Section of chemical laboratory. Many trained women chemists are employed in this laboratory



Analytical distillation equipment and part of the chemical laboratory staff

phoned to operating departments as soon as available, subject to later written confirmation.

The personnel of the control laboratory consists of approximately 90 people. Half of these are young women. All of the male employes have had a thorough technical education, and the majority of the women employes have a college degree with varying amounts of chemical training.

The research laboratories are still in the early stages of development. However, facilities have been provided for handling a research staff commensurate in size with other activities. Future plans include the development of these laboratories for both fundamental and plant problem research work.

The Butadiene Laboratories

These laboratories are primarily established for control of butadiene manufacturing operations. The butadiene control laboratory is a brick, one-story building, 100 ft. by 40 ft. The building is so arranged that the control analyses are conducted in five main laboratory rooms.

The gas analysis laboratory is equipped with four Hyd-Robot low-temperature fractional distillation units and equipment for absorption analysis using bromine or sulfuric-acid absorption. Other chemical methods of gas analysis, such as hydrogenation or anhydrous hydrogen chloride reaction, are also used. Both infrared and ultraviolet spectrophotometer are used, either in conjunction with the low-temperature fractional distillation units or as a primary means of analysis.

The general chemical laboratory is equipped with all of the latest analytical tools and apparatus used by the analytical chemist. This laboratory carries out detailed and complicated analyses of plant streams, raw materials, processing solutions and finished grade butadiene.

The physical testing laboratory is equipped with the necessary standard apparatus for making physical measurements and tests on liquid hydrocarbon samples. The volume of this type of work is relatively small as contrasted to the work required of the other laboratories.

The personnel of the butadiene laboratory consists of 40 people. Half of this group is made up of young women. All male employes are graduate chemists or chemical engineers and all of the women are college graduates with varying amounts of chemical training.

Future expansion of this laboratory is planned to include research and development work on the many problems relating to butadiene manufacture.

The Pilot Plant

This unit will consist of a 7-bbl.-per-day crude topping unit, a 2.5-bbl. propane deasphalting and desalting unit and a 2-bbl. fluid catalytic cracking unit, all housed in a building 44 ft. by 82 ft. on the first floor and 4 upper decks 17 ft. by 41 ft.

The high, central portion of the building will be equipped with a 5-ft. 6-in. walkway lengthwise through the center and thus allow a 5-ft. space on each side for equipment. Each side is equipped with a trolley beam to allow the use of a trolley and chain hoist for installing equipment.

All units are so designed that they can function to produce products similar to those produced in the basic plant. The units are equipped with temperature, flow, pressure and level controls to make the operation as automatic as possible. The topping and fluid catalytic cracker will have electric heaters on lines and equipment to offset radiation.

A 450-kva. transformer is provided to carry the power and heating load. A 50-kva. transformer is provided for lighting.

The deasphalting and desalting unit will be provided with steam heaters.

All process steam for stripping, etc., will be controlled and provided by pumping distilled water through electrically heated lead bath steam generators.

The topping unit will consist of a 1 by 4-ft. salt settler, a 21 ft. by 8-in. fractionator arranged for side streams to cut kerosene, light gas oil and heavy gas oil and each side stream is equipped with a 3 ft. by 4-in. stripper.

The propane deasphalting and desalting unit will consist of a 1 by 4-ft. settler and a 6 ft. by 6-in. flasher and a stripper of the same size for the deasphalted oil and the asphalt-salt cuts.

Pilot Plant Units

The fluid catalytic cracking unit will consist of a 19 ft. by 8-in. regenerator, a 24 ft. by 4-in. reactor, a 16 ft. by 8-in. fractionator with provisions for side streams of light and heavy gas oil, 3 ft. by 4-in. stripper for the side streams and a 15 ft. by 6-in. stabilizer.

The reactor and regenerator are each provided with settling space and with 4½ by 36 in. long, Aloxite, (5 permeability) filters to prevent catalyst carryover. The filters will be blown back with air on the regenerator and steam on the reactor; the operation being carried out by remote control.

The stabilizer is so laid out that all the overhead from the fractionator can be processed in the stabilizer, thus providing for a maximum yield of the stabilized product.

The above equipment permits the following studies of operations: (a) study present processes to determine optimum conditions in each step for the production of maximum aviation gasoline from crudes now available; (b) determine similar conditions for crudes upon which there is at present no background for our processes; (c) join in the problem of determining the conditions for catalytic cracking which will permit the production of suitable base stock from any crude, and (d) determination of optimum conditions for post-war operations.

Thermal Processing Units Have Combined Capacity of 127,500 Barrels Per Day

by W. T. Cravens and B. H. Mylius

Thermal reforming unit operating on straightrun naphthas

THE thermal processing units include two 40,000 bbl. per stream day M. W. Kellogg Co. designed topping units, a 14,250 bbl. per stream day desalting and deasphalting unit designed under Juik process, a 23,250 bbl. per stream day straightrun gasoline fractionating unit and a 10,000 bbl. per stream day naphtha-reforming unit.

East Texas and South Louisiana crude is charged to the topping units and it is split here into a 360° F. end point overhead straightrun gasoline stream, side streams of kerosene, light gas oil and heavy gas oil, and reduced crude bottoms.

The overhead gasoline stream is pumped direct to the straightrun fractionation unit where it is processed to produce propane, butanes, isopentane, light virgin naphtha and heavy naphtha. Butanes, isopentane and light naphtha are pumped to the treating plant and thence to storage for (1) feed stock to alkylation unit, (2) blend to 100-octane aviation gasoline and (3) blend to secondary aviation gasoline, respectively. Propane goes to the plant fuel gas system where it is mixed with other refinery gas and natural gas to be burned under stills and boilers.

The side streams from the toppers are charging stock for the catalytic-cracking units. Some kerosene is treated for the market and some light gas oil is produced to diesel fuel specifications.

The reduced crude from the toppers is pumped direct to the desalting and deasphalting unit where it is further separated as desalted gas oil and asphalt. The gas oil is blended with side streams from the toppers for charge stock to catalytic-cracking units. Asphalt is blended with thermal cracked gas oil and thermal bottoms to produce salable fuel or burned as such under the low-pressure boilers.

W. T. CRAVENS

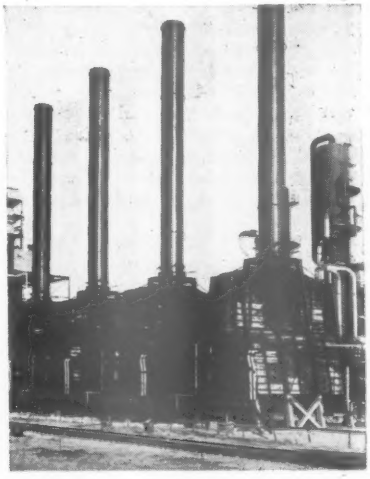
B. H. MYLIUS

W. T. Cravens was born in Fort Smith, Ark., and received the bachelor of science degree in 1936 from University of Arkansas. He became a trainee in engineering with Arkansas Fuel Oil Co. in 1937, and later joined Cities Service Refining Corp. in October 1942.

B. H. Mylius came from Tennessee and attended Stanford and Arizona universities. He has worked for the Cities Service organization since 1923, as chemist, "trouble shooter," and departmental supervisor in various refineries. He is married and has three children.

Toppers

The two toppers are identical in design. The large size of the principal items of equipment is not readily apparent to the eye as all units are proportionately large in size. The main crude towers are 19 by 90 ft. plus 9 by 10 ft. and the stripper towers are 6 by 48 ft. The main crude tower top temperatures are controlled by a top tray and intermediate reflux system. Tower design permits separation between the gasoline and kerosene to produce 20° F. difference between the maximum boiling point of the gasoline and the initial boiling point of the kerosene, as determined by the A.S.T.M. Engler distillation. It will be noted that a naphtha side stream is not produced from these towers.



Heaters for reboilers on the catalytic fractionating units

The furnaces present a massive and imposing picture. The furnace tubes are 6 in. by 60 ft. in length and there is approximately 2 miles of tubes in each furnace. The furnaces are the "upfired" type and the floor is 8 ft. above grade. There are 130 burners in the floor section. Suspended walls and arches are utilized. The furnace outlet tem-

View of topping units where all plant crude is fractionated initially

perature is controlled automatically.

Steam turbine and motor-driven centrifugal pumps are used throughout the units. Heat-exchanger equipment is very efficient. Pressure is used to combat fouling due to salt in crude. Cooling boxes are of reenforced concrete and coils are cast iron and steel. Relief valves are provided for all equipment with discharge lines piped to a centrally located drum and field-flare system.

Control rooms are modern and similar in design. All structures for exchangers, drums, pedestals and stairways are built of reenforced concrete in order to conserve steel.

Desalting and Deasphalting Unit

This unit charges the reduced crude bottoms from the topping units, blends same with liquid propane and, under controlled temperature and pressure, effects a separation of desalted gas oil and asphalt. Propane is recovered and recycled. The prime purpose of the unit is to produce a desalted gas oil for charging stock for the catalytic-cracking units (salt would have a deleterious effect in the catalytic-cracking units), and to reduce the asphalt produced to a minimum—3 per cent South Louisiana crude and 5 per cent East Texas crude. The maximum carbon residue of the desalted gas oil is 2.6 per cent and this stock produces more fractions from catalytic cracking suitable for butadiene production than any other charging stock. So far as is known, this is the only refinery utilizing propane deasphalting for production of charging stock for the catalytic-cracking units.

The separation of asphalt and desalted gas oil is effected in settlers at 525 lb. pressure and a temperature of 140° to 185° F. The higher temperature produces the maximum quantity of asphalt. An oil-propane ratio of 1:4 is charged to the settlers and the asphalt-propane ratio from the bottom of the settlers is 1:1 while the balance of the propane goes overhead with the gas oil. The asphalt-propane is charged through furnace coils to a flash drum and thence to a stripper tower, propane being recovered from each. The gas oil-propane from the settlers is charged through low-pressure steam (25 lb.) evaporators, high-pressure steam (230 lb.) evaporators, and thence to desalted oil-stripping tower. Propane returns to condensers and storage tank under generated pressure except from the stripper towers. Propane goes from the stripping towers to a jet condenser and thence to a dry drum. Two 600-hp., 2-stage natural-gas engine-driven compressors take suction on propane from the dry drum and deliver it to the storage tank via the condensers.

Several new features have been incorporated in the design of this unit. The size of the unit warranted a gas-fired furnace coil for recovery of propane from asphalt instead of the conventional steam reboiler type. The asphalt settlers are mounted on cradles at an angle instead of in an upright position and baffling on the interior of the settlers is designed to effect efficient separation between gas oil and asphalt. Steam tracing of piping was engineered to give best results instead of being left to field construction forces to install.

Straightrun Fractionation Unit

This unit receives charge of overhead gasoline from the toppers and natural gasoline pumped from storage tanks, the latter being charged to separate the isopentane and concentrate the isobutane content of the natural gasoline.

Principal equipment of this unit consists of four towers—prefractionator, depropanizer, debutanizer and isopentane — with auxiliary equipment.

The prefractionator separates the charge into an overhead stream of 240° F. final b.p. and a heavy naphtha of the same initial b.p. (charge stock for naphtha reform unit). The overhead is charged to depropanizer for propane removal and thence to the debutanizer for separation of butanes and isobutane and further to the isopentane tower for separation of isopentane. The bottoms from the latter tower blend to secondary aviation gasoline. The overhead from the prefractionator tower can be varied to produce many desirable blending stocks from the isopentane tower bottoms for 100-octane aviation gasoline, secondary aviation or 80-octane all-purpose blend.

Naphtha Reform Unit

Prime purpose of this unit is to process heavy straightrun naphtha to produce B-B cut for butadiene and alkylation processing and raise the octane number of the gasoline.

Flexibility in design permits several operations. It can be operated to produce reformed naphtha, condensate product, motor gasoline base stock, tar and gas, or without producing the reformed naphtha stream. It can be used to crack gas oil (catalytic-cracking gas oil) and the products are: motor-gasoline base, cracked gas oil, tar, condensate product and gas.

Reformed naphtha forms a portion of the feed stock for the catalytic-cracking-retreat unit. The condensate product contains a preponderance of the B-B fractions and it is pumped direct to the catalytic-cracking fractionation unit where it is depropanized and blended with the B-B fractions from these units for feed stock to the butadiene plant. Motor gasoline base stock is pumped direct to the treating plant and thence to storage for blending to 76-octane-number motor gasoline.

These tanks handle and store much of the intermediate as well as finished products made in the refinery

Oil Flow and Storage Plan

by H. R. Smith

THE modern large refinery with its complex interconnecting piping system between process units and tankage, offers to the design engineer a plant layout problem of considerable magnitude. In conceiving and setting up an ideal arrangement, compromises must be made. The system must be adequate for normal operating needs or emergencies, yet not so complex as to jeopardize simplicity of operation. Under existing conditions, its adequacy must be carefully balanced against its critical material requirements.

The processing units for this refinery have been arranged in two perpendicular rows forming an L, the various type units being placed in the most advantageous position with relation to the other units.

H. R. Smith is a Louisianan, graduated from Louisiana Institute of Technology in 1923, worked as refinery engineer with Louisiana Oil Refining Corp. and other Cities Service subsidiaries for several years. The last 9 years before joining Cities Service Refining Corp. in 1943 he was superintendent for Arkansas Fuel Oil Co. at Shreveport. He is now assistant process superintendent for the Refining Corporation.

The crude fractions are separated at the apex of the L and are processed as they proceed outward along the branches from which the products converge into the enclosed area through intermediate storage to the treating and ethylizing units or the main transfer pump manifold. This arrangement provides a simple direct piping system between processing units and finishing which is highly efficient from a pumping and operating labor standpoint. The docks, loading racks and pipe-line outlet are ideally located around the finished-product-storage tanks.

To provide the necessary facilities for transfer of feed and products are four major manifolds: crude booster, transfer, gasoline loading and fuel-oil loading. The location of the majority of the pumps at these strategically situated manifolds permits the use of one pump for several duties and has decreased the number of pumping units required while keeping the necessary flexibility of operation.

The crude booster pump manifold is centrally located in the crude storage area and serves to deliver all crude oil to the suction of the topping-units charge pumps.

The transfer-pump manifold handles all the required movements for

Ocean-going tanker loading at main dock

most of the hydrocarbon fractions produced. Most feed stocks and components of finished products are supplied through this manifold. All intermediate tankage and any extraneous feed requirements are handled here. By judicious arrangement only 11 pumps ranging in capacity from 300 to 2,500 g.p.m. handle a total of 59 suction and discharge lines ranging in size from 6 to 16 in. in diameter. Although covering an area of 22,500 sq. ft., operation can be handled with a minimum of labor and a maximum of efficiency.

The gasoline loading manifold is located in the 100,000-bbl. finished-gasoline storage area. It includes seven motor-driven centrifugal pumps, handling aviation, 80-octane all-purpose, ethyl and motor gasolines. It pumps gasoline to barges or tankers at the docks, tank cars at the loading racks, and to the War Emergency Pipeline system. These pumps have a capacity of from 105,000 to 210,000 bbl. per day.

The fuel-oil loading manifold (see picture) is in the finished fuel-oil storage area. It includes seven motor-driven centrifugal and one steam reciprocating pumps handling kerosene, No. 2 fuel oil and No. 6 fuel oil. Like the gasoline loading pumps, it pumps to the docks, loading racks and to the War Emergency Pipeline. The steam pump has a capacity of 52,800 bbl. per day, the centrifugals varying from 80,000 to 205,500 bbl. per day.

In addition to the four major manifolds previously described, there are 10 pumping stations consisting of one to five pumps, handling either very viscous or very volatile material.

The large pump manifolds are installed in concrete pits, provided with adequate drainage, for safety and to promote good housekeeping and working conditions.

The pumping equipment consists almost entirely of electric-motor-driven centrifugal pumps of low and medium head. Mild climatic conditions permit the location of pumps in the open.

A 12-in. line from Sour Lake, Tex., having a capacity of 50,000 bbl. per day handles a portion of the refinery's crude requirements. Finished products such as gasoline, kerosene and No. 2 fuel oil can be delivered via pipe line to the WEP product line's booster station where it is discharged through an 8-in. trunk line to the main products line for supplying the East Coast. Products are delivered to the booster station at the rate of approximately 30,000 bbl. per day.

For the shipment of finished products by tank cars, four loading racks have been provided, each of which will handle 28 tank cars, or a total of 112 tank cars. Unloading facilities for natural gasoline and crude have been provided capable of handling 28 cars.

Since the bulk of the crude and the finished products is water borne, much time and thought was given to the design and layout of dock facilities. War needs make it imperative that waiting time and loading time for barges and tankers be kept at an absolute minimum. (The Calcasieu River upon which this refinery is located is navigable by ocean-going tankers.)

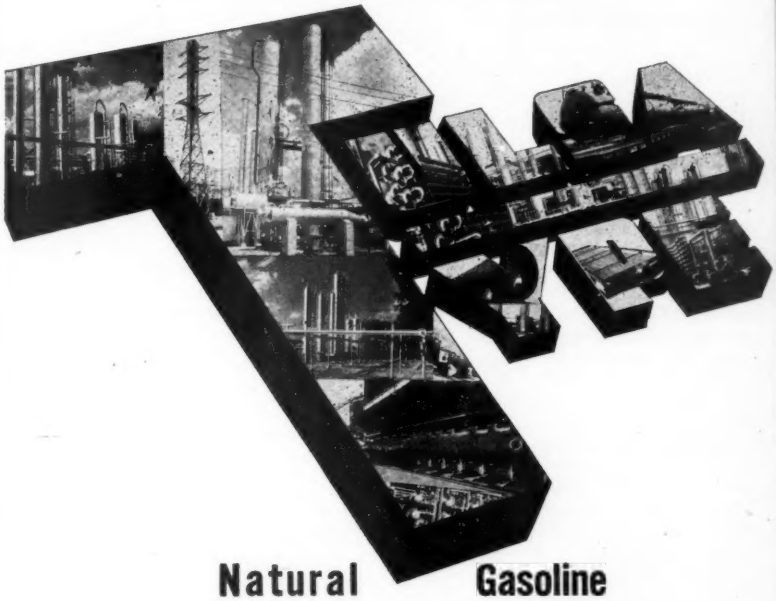
Three separate docks have been installed, two for tankers and one for barges. One of the tanker docks can accommodate barges. Twenty-inch lines have been laid to the docks for all finished products except No. 6 fuel. Two 12-in. lines have been installed for No. 6 fuel oil.

Gasoline may be loaded at the rate of 17,000 bbl. per hour, kerosene and No. 2 furnace oil at the rate of 15,000 bbl. per hour, and No. 6 fuel oil at the rate of 9,000 bbl. per hour.

Crude may be unloaded from tankers or barges into the line to the crude farm. At the barge dock, there are two reciprocating steam pumps to unload crude at the rate of 52,800 bbl. per day each.

Ballast from the tankers can be handled at the rate of 5,000 bbl. per

The new Cities Service Refining Corporation's 100 Octane Aviation Fuel Plant at Lake Charles, La. is one of the many plants throughout the nation Equipped For War with—



Natural Gasoline and Refining Equipment

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TULSA, OKLAHOMA

Main oil-transfer manifold

hour. In addition to the above-mentioned loading facilities, a bulk loading station has been provided for handling local shipments by tank truck.

Tank Dispatcher

To keep products moving in an efficient and orderly manner, the operation of all tankage and all piping outside of the individual processing units has been placed in the hands of the transfer department.

A tank dispatching system, similar in many respects to a train dispatching system, has been set up within the transfer department. The tank dispatcher is centrally located. The tankage area is divided up into sections to which one or more pumpers and gagers are assigned. Tank gages are phoned into the tank dispatcher at regular intervals. The latter also receives information from the processing units as to rates of flow and expected changes in rates of flow. Having this information, the tank dispatcher directs and controls all switching, pumping and gaging operations. The dispatcher also arranges for regular and special sampling.

It is only with this closely coordinated control that this plant is able to carry on the many and varied operations with such limited tankage.

For the operation of a plant as large as the Lake Charles refinery, a great many tanks are required. Because of the shortage of steel, great care was taken to keep the number of tanks at a minimum, consistent with operating needs and contractual storage requirements.

It was finally decided that the lowest number of tanks required to operate this refinery would be 126, of which 110 are atmospheric and 16 are pressure storage. The atmospheric storage tanks are as follows:

No. tanks—	Size (bbl.)
15	100,000
22	80,000
10	25,000
38	10,000
10	2,500 to 8,000

Pressure storage consists of spheres and spheroids for storing volatile hydrocarbons. Pressure storage consists of the following:

No. tanks	Size (bbl.)	Operating press. (lb.)
2	25,000	10
2	10,000	25
2	2,500	25
5	10,000	75
3	5,000	75
2	2,500	75

Crude storage totals 1,265,000 bbl., consisting of eleven 80,000 bbl. and seven 55,000-bbl. tanks.

Shipping tank storage totals 1,500,000 bbl., consisting of fifteen 100,000-bbl. tanks. This size tank permits rapid tanker loading and since all finished gasoline tanks are equipped with floating roofs, the number of special roof installations is kept at a minimum. The gasoline shipping tanks are equipped with mixers, so that all gasoline blending operations are performed in these tanks. All shipping tanks are located on the south side of the refinery.

Intermediate storage consists of 58 atmospheric tanks with a capacity varying from 2,500 bbl. to 25,000 bbl. and 16 pressure storage tanks varying from 2,500 bbl. to 25,000 bbl. These tanks are located between the legs of the L in such a manner as to keep the distance between the units and the tanks at a minimum.

In addition to the above-mentioned tanks, there have been provided six 80,000-bbl. tanks for the storage of such material as catalytic-cracking feed, gas-recovery feed, etc.

Other finished product storage totals 840,000 bbl., consisting of five 80,000-bbl. and eight 55,000-bbl. atmospheric tanks. These tanks are located west of transfer manifold.

All storage tanks are equipped with proper flame arrestors and, where necessary, with vacuum and pressure vent valves. All atmospheric storage tanks have one or more foam chambers installed with foam lines extending outside the firewall. The refinery firewater system provides protection to all tankage.

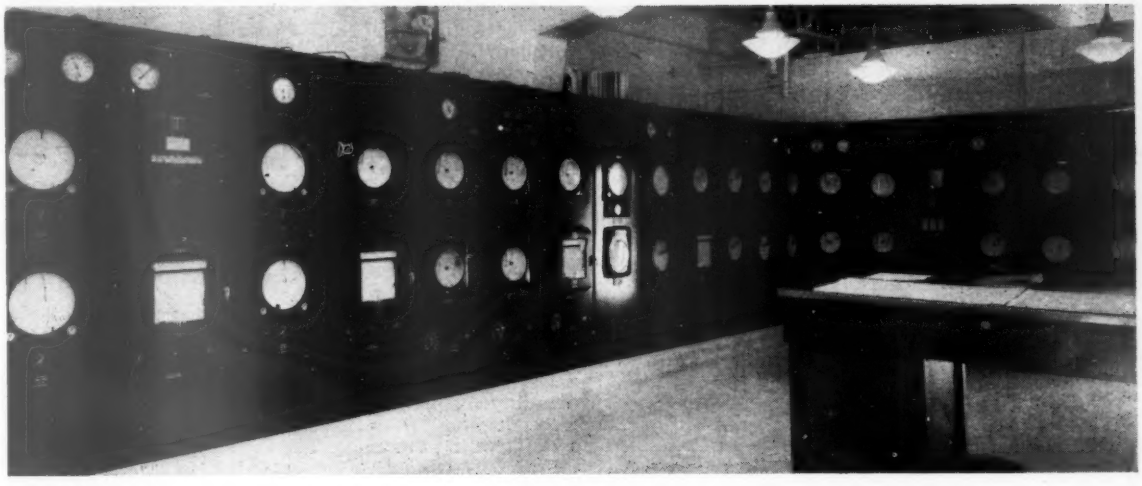
The shell-to-shell spacing of these tanks is generally in accordance with or greater than that recommended by insurance underwriters.

To save steel, all oil lines are installed on concrete sleepers slightly above grade, thus greatly reducing the need for steel supports. Fixed anchor supports are provided at proper locations, with slight bows in the pipe to care for expansion. Small safety valves protect the lines from excessive pressure due to liquid expansion when closed off.

Valves on main oil manifold

Nearly 1,600 Instruments Installed in Basic Refinery and Butadiene Plant

by E. D. Mattix and R. W. Groendycke



Instrument assembly on one refinery unit

AS an indication of the extent to which instruments and automatic controls are used, we have installed 1,250 instruments in the basic refinery and 330 in the butadiene plant, not including thermometers, gage glasses and pressure gages.

In the initial layout of the unit considerable thought was given in the selection of instrumentation from the viewpoint of standardizing on instrument suppliers, in order to minimize the number of spare parts and for flexibility for future instrument changes. For example, one supplier was chosen for pneumatic transmission instruments, another for direct connected instruments. One company was chosen for multipoint potentiometer temperature recorders, while the temperature controllers and indicators were procured from another. Bulb type temperature controllers were eliminated because of the proneness of this type to breakage of capillary tubing and over-ranging of the instrument, and the long time required to repair them. All positioners were purchased from one manufacturer and control valves from another. Other instruments were selected where it was believed that they would give better performance than those in the general classification.

The instrument air supply has been covered in the story on the power house in this section. The arrangement is so laid out that instruments have first call on air from the power house. The drying is especially essential due to the high humidity which prevails in the area of Lake Charles.

A bypass is provided so that in event of repairs to instrument air, air can be procured from plant air line.

The electric supply is obtained as a branch of the lighting circuits in each area.

In case of failure of current the instruments are supplied from the emergency lighting circuit, which cuts in automatically upon failure of the regular source.

A relatively new and very effective tower control has been applied to those fractionators where it is desired to remove overhead all of one component. The tower is instrumented with a pressure controller (PRCa-1) regulating the quantity of heat to the reboiler. A temperature controller (TRC-1) is installed with a sensitive element in a selected tray between the point of feed and the top of the column. A proportioning ratio relay (SP) is installed which is operated by the feed flow controller (FRCa-1) transmitter air pressure and the temperature controller and whose output sets the index on a flow controller (FRCa-3) on the overhead product. A flow controller (FRCa-2) is provided for the reflux and in practice the reflux is set to the maximum possible as dictated by: (1) capacity of pump or piping; (2) capacity of condensers; (3) capacity of reboiler, and (4) capacity of column as determined by downcomers or vapor velocity. Any change in pressure in the column is corrected by the pressure controller (PRCa-1) throttling the flow of steam to the reboiler.

E. D. MATTIX *R. W. GROENDYCKE*

E. D. Mattix comes from Ohio, has been employed by Standard Oil Co., Pure Oil, Phillips, and other companies including the Kellogg Co., before joining Cities Service Refining Corp.

R. W. Groendycke was born in Iowa, raised in Texas and in Kansas City, Mo. He served as service engineer for 16 years with Brown Instrument Co., joining Cities Service at Lake Charles in August 1943.

The temperature controller (TRC-1) acting through the proportioning ratio relay (SP), controls the overhead product withdrawn from the column. In case the per cent of heavy components in the feed increases the control-tray temperature will have a tendency to rise. Therefore the temperature controller will reduce the ratio between the feed and the overhead production, thus increasing the amount of the lighter product at the temperature point and vice versa. This seems to operate on a physical displacement principle. In case of a change in rate of feed, the feed flow controller acting through the proportioning ratio relay, makes a proportional adjustment in the product withdrawn. The results obtained are indicated by the following data:

When feeding 305 bbl./hr. of 340 ep. naphtha, temperature on 9th tray—162° F. reboiler—308° F.

Bottoms		Overhead per cent	
A.P.I. Gr.	54.2	C_3	3.70
I.b.p.	108	C_4	94.20
10 per cent	136	C_5	2.10
30 per cent	162	..	....
50 per cent	210	..	....
70 per cent	265	..	....
90 per cent	300	..	....
Ep.	340	..	....

When feeding 410 bbl./hr. of 200 ep. naphtha, temperature on 9th tray—160° F. reboiler—236° F.

Bottoms		Overhead per cent	
A.P.I. Gr.	85	C_3	10.6
I.b.p.	95	C_4	88.6
10 per cent	101	C_5	0.8
30 per cent	105	..	....
50 per cent	107	..	....
70 per cent	116	..	....
90 per cent	138	..	....
Ep.	196	..	....

The Pod analysis on both of the bottoms samples indicated no C_4 present.

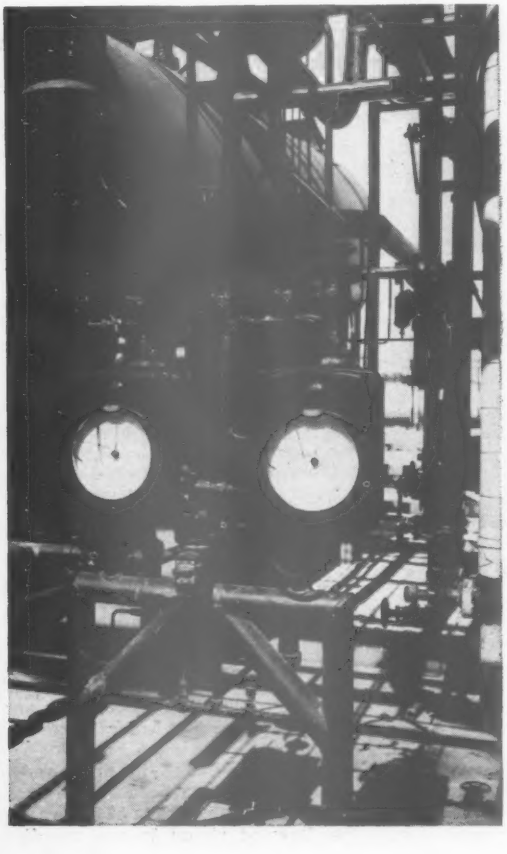
In the second case the high percentage of C_3 is present by intention as the B-B cut when charged to the alkylation unit would yield C_3 to make the initial charge to the deasphalting and desalting unit.

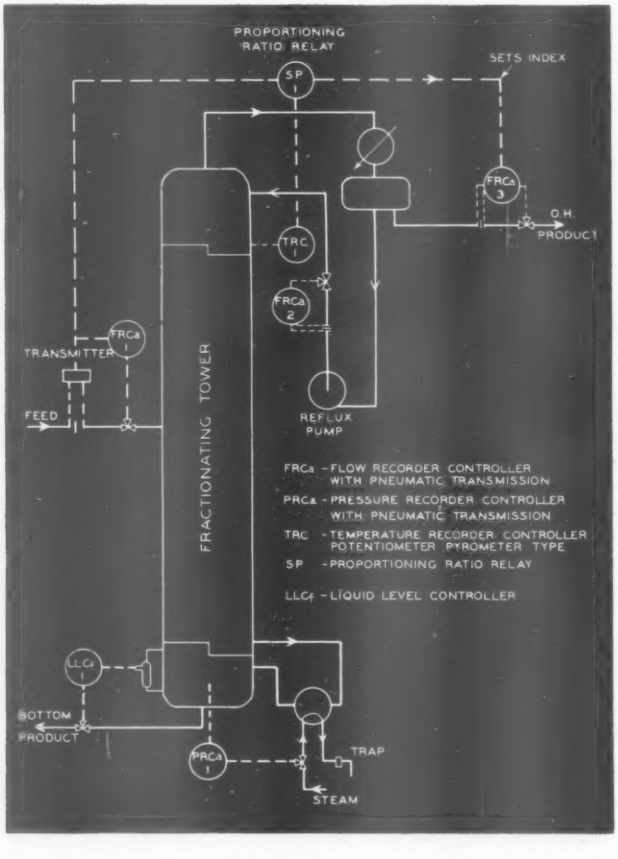
In the case of treating kerosene with fine earth, we are faced with a requirement of proportioning a powder to a liquid. In this case, a flow meter on the kerosene feed proportions the speed of a star feeder by means of a Reeves drive. Such equipment has been used in proportioning powdered fuel to air, but this seems the first application in petroleum.

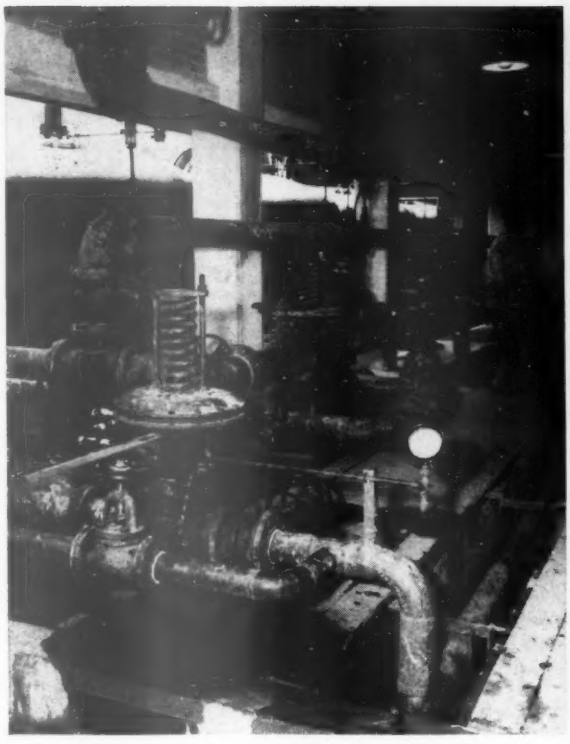
In the case of high duty reboilers, steam traps on the condensate may cause considerable variation in pressure when they discharge. In order to avoid such pressure disturbances we have used accumulator drums on the outlet and level controllers in place of traps. In those cases

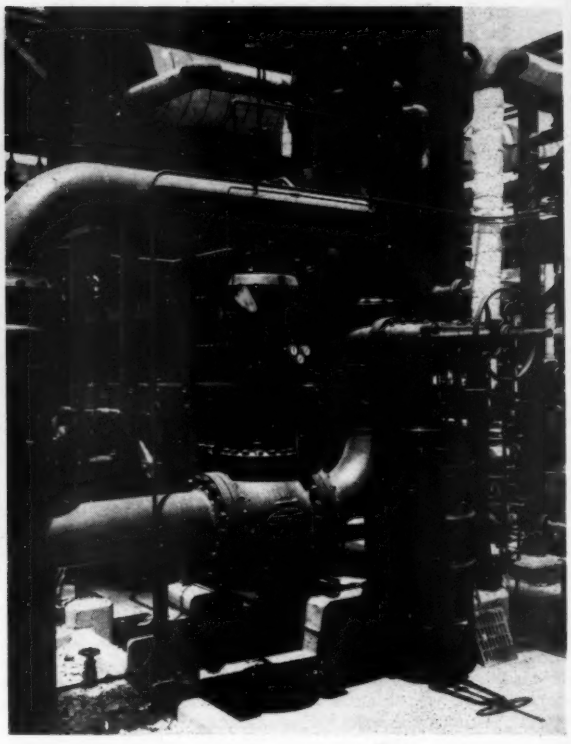
Flow regulators on hot water return lines

Left: Recording flow meters. Right: Instruments and their arrangement on a typical fractionating tower









Left: Diaphragm regulator valves, in butadiene unit. Right: Large size flow regulator

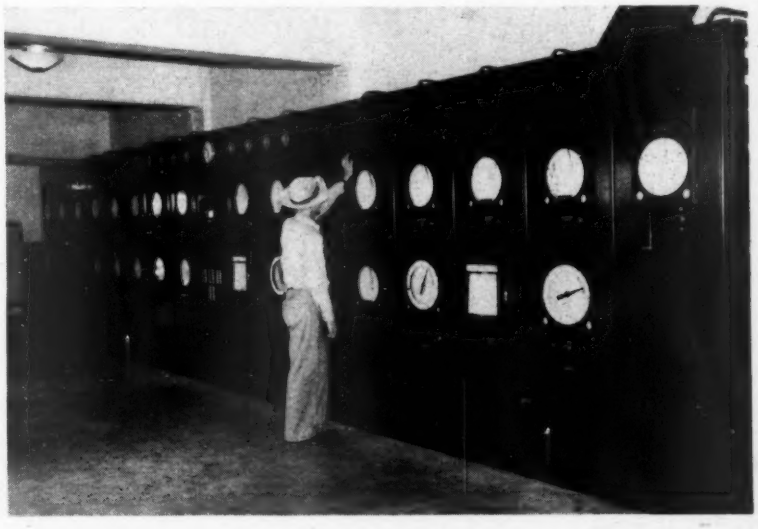
where the temperature required is so close to the atmosphere boiling point of water that there is no pressure to cause the trap to function, then a flow controller is installed with the orifice in the steam line, the valve in the condensate and the index sets the amount of heat. Any change in back pressure on the low side of the valve is overcome since the flow of steam is maintained.

Catalytic Cracker Instruments

Most of the slide valves on the catalytic crackers are installed in duplicate and either the upper or lower may be used for automatic control and the service may be changed from one to the other by a four-way valve on the control board. The automatic control may originate from a differential recorder controller and by air control operate the hydraulic positioner which uses a cam to detect position of the valve and balance it on a fulcrum arm against the controlled air output pressure from the instrument. Any unbalanced condition between the two causes the pilot to feed oil to one end of the hydraulic piston valve operator and exhaust it from the other until the valve causes the fulcrum arm to come back to balance.

In general all instrument boards are laid out to provide as much ease of operation as possible. As an example, at the catalytic crackers the board is in the form of an inverted U as we approach from the unit. On the left, the board covers the air and catalyst controls starting with air and covering the operations of the regenerator with the analysis of the flue gases in the approximate center of the U. Following are the controls of feed, the operations of the reactor, the fractionator and finally the products.

Long before the plant was completed it was realized that sufficient qualified instrument men could not be obtained without an extensive training course. Two classes of about 16 men each were selected and after a short period of training at the plant, were sent to two instrument schools for a period of about 2 months and after returning were given further instruction pertaining mostly to processes of the units and the application of the instruments thereto. Since the completion of this training, the instrument personnel has been further increased.



Instrument control board

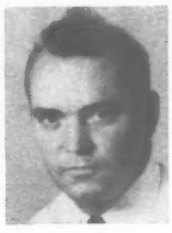
Eight Different Fractions Are Treated Chemically in Five Separate Units

by W. H. Price and T. G. Gray

IN a modern oil refinery designed to produce the maximum percentage of aviation gasoline the chemical treatment of certain fractions is of great importance. In the Tutwiler refinery of the Cities Service Refining Corp., eight different fractions are chemically treated. In laying out the refinery it was found that the arrangement of the processing units in an L shape on two sides of the intermediate storage tankage made it possible to locate all treating equipment in a single area without an appreciable increase in rundown piping. This arrangement decreased the chemical piping to a minimum. It also permitted the creation of a department whose sole responsibility is chemical treatment. Experience indicates that this procedure is more desirable than making chemical treatment a stepchild of another processing unit.

The treating plant consists of five separate units designed to treat various products of the refinery. A regenerative-caustic unit extracts mercaptans from isopentane, a butane stream, a butane-butene stream and a C_5-150° stream. A Unisol unit designed by Universal Oil Products Co. is used to remove mercaptan sulfur from two separate gasoline streams. There are in addition to these two systems an aviation base treater, a kerosene treater and a furnace-oil treater. The treating

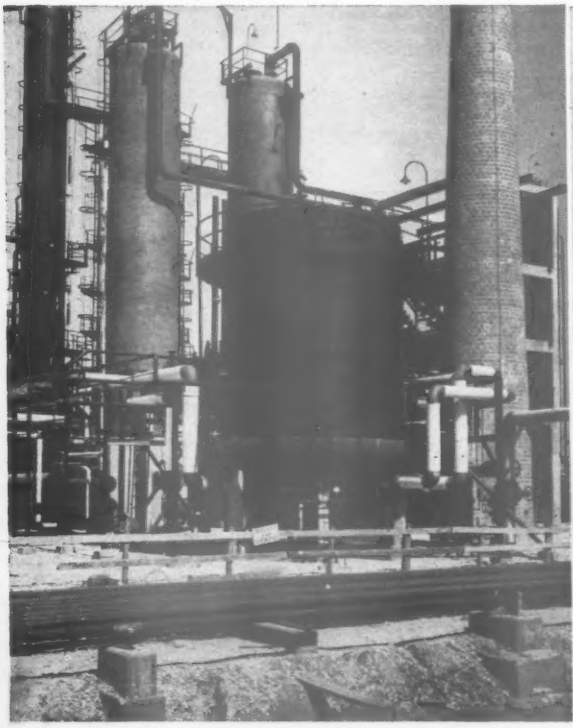
W. H. PRICE

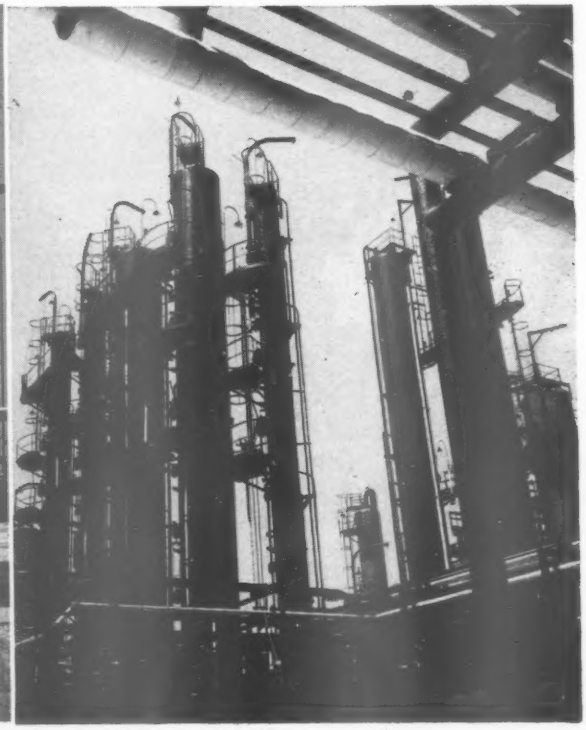


T. G. GRAY

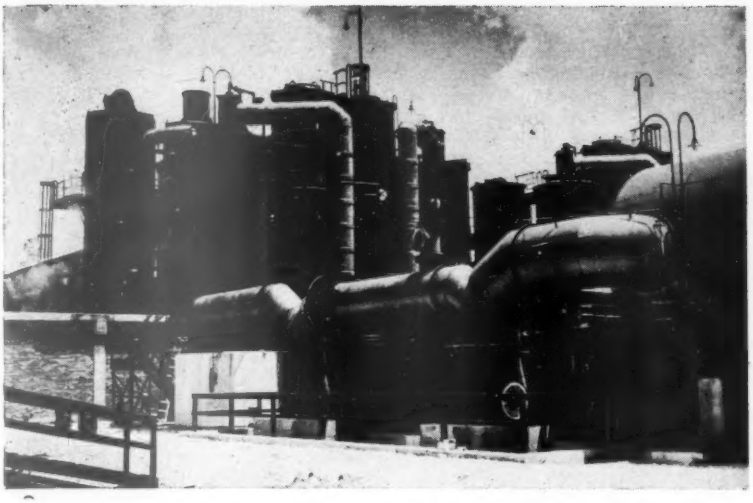
W. H. Price studied engineering at Iowa State College up to 1924, worked for Cities Service Oil Co. until 1927, received a bachelor's degree in petroleum refining, University of Pittsburgh, in 1928. Later he served in various positions up to that of process engineer and assistant to the general superintendent of refineries in the New York office, joining the Refining Corporation in 1942 as process superintendent.

T. G. Gray was made superintendent of the acid plant, treating plant, and transfer department at Lake Charles, after climbing the Cities Service ladder from research chemist at East Braintree in 1928, to refinery engineer, New York, to assistant refinery superintendent in East Braintree. He was graduated with the bachelor degree in chemical engineering from Purdue University in 1928.





Left: A preheater unit, in the treating plant. Right: Main battery of fractionators in the treating plant



View of the sulfuric acid manufacturing and recovery plant

plant also prepares dilute caustic and pumps it to the various units.

Regenerative Caustic Unit

Caustic solution, 12° Be., is very effective for removing mercaptans from low-boiling-point hydrocarbons and the mercaptans can be removed from the spent caustic by steam stripping. Owing to its simplicity this method of treatment was chosen for the removal of mercaptans from the C_4 and C_5 fractions.

Isopentane, straightrun butanes, a butane-butene stream from cracking operations and a C_5-150° F. stream from catalytic cracking are treated in separate towers in this unit. The extraction with caustic is carried out in towers packed with carbon raschig rings. In the case of butane cuts, a preliminary caustic wash is given in the lower section of the same tower in which the mercaptan extraction is accomplished in order to remove any hydrogen sulfide which might be present. All cuts are given a water wash in the upper section of the extraction towers.

The caustic used for the extraction of mercaptans is regenerated by stripping with steam. This regeneration is carried out in two towers, one handling the caustic used for extraction of mercaptans from the various butane streams and the second handling the caustic used for extraction of mercaptans from the streams having the general boiling range of pentane.

Properties of the various materials involved indicate that the extraction of mercaptans in the case of the butane cuts is easier than that required in the heavier cuts. Conversely, stripping of the mercaptans from the caustic used for the pentane boiling range cuts is easier than in the case of the caustic from the butane-cut extraction. In view of this, the unit has been designed so that the caustic is used for the heavier cuts first and the lighter cuts later. However, owing to the necessity of having well stripped caustic for the heavier cuts, the steam is first used to strip the mercaptan from it and then reused to strip the caustic used for the extraction of the lighter ends.

The design quantity of each of the streams is given below:

	Designed bbl. per stream day
Thermally cracked B-B	1,605
Catalytically cracked B-B	9,020
Straightrun butanes	5,000
Catalytically cracked C_5 — 150° F	9,840
Straightrun isopentane	1,500

Aviation Base Treater

Aviation base stock as produced in the catalytic fractionation unit is treated to remove any traces of mercaptan that may be present and to improve gum stability. The treatment is simple and the unit involves one packed tower divided into two sections. The lower section through which the base stock passes first, serves to wash the gasoline with 12° Be. caustic; the upper section to which the base stock passes serves as a water-wash section to remove all traces of caustic. The treated product, after leaving the top of the tower, receives a continuous stream of inhibitor solution, and then flows to storage for blending into finished aviation gasoline. In this system the aviation base is treated and inhibited immediately after it leaves the catalytic cracking fractionation system.

Unisol Unit

The Unisol process is used to extract mercaptans from gasoline producing a marketable product in one step. Sweetening methods used in the past for the purpose of finishing gasoline converted mercaptans to disulfides which remained in the product. The Unisol process by actually removing the mercaptans, reduces the sulfur content of the gasoline by the amount of the mercaptans originally present, increases the octane number slightly and usually improves lead susceptibility.

The Unisol units consist of two separate systems, each of which has a design capacity of 12,500 bbl. per day. It operates under U.O.P. license.

In order to simplify the discussion of this unit only one system will be described. The first step in the treatment for the removal of hydrogen sulfide and aliphatic acids in a continuous counter-current type prewash column wherein the gasoline stream is contacted with dilute caustic prior to entering the mercaptan extraction column.

Mercaptans are removed from the gasoline by counter-current extraction with a concentrated aqueous solution of caustic soda containing methanol. This operation is carried out in a packed column. Aqueous soda solution is introduced at the top of the column and moves downward counter-current to the rising flow of gasoline. Methanol is introduced at a point midway in the column. The caustic soda solution in the upper portion of the column above the methanol inlet selectively extracts methanol from the gasoline and thus prevents methanol loss. The portion of the column below the methanol inlet is the mercaptan extraction section.

The methanol and mercaptans are removed from the caustic solution by heating and stripping with steam. The recovered caustic is circulated back to the extraction column for reuse.

The methanol and mercaptans together with the steam used for stripping are condensed and sufficient water is added to produce a methanol water mixture in which the mercaptans are substantially insoluble. The mercaptans separate to form an oil layer over the methanol water and are removed from the process as a liquid.

Methanol is recovered from the methanol-water solution in the mercaptan separator by distillation in a fractionating column which serves both systems. The recovered methanol is circulated back to the mercaptan absorber towers for reuse.

Kerosene Treater

Kerosene is chemically treated so that it will be possible to yield this product at a uniform rate throughout the year without sacrificing quality in spite of long storage periods. This kerosene treating unit produces a finished product that is sweet and bright and of good color. In order to accomplish this, the treatment of kerosene is carried out in three stages: (1) doctor sweetening; (2) acid treating, and (3) clay treating.

The doctor sweetening is carried

out continuously in settlers. Two settlers are provided and they are connected so that they may be operated either in series or in parallel. Settlers contain closely spaced inclined baffles to increase their efficiency. Doctor solution is sent to the spent-doctor tanks after being withdrawn from the settlers. From the spent-doctor tanks it may be pumped to the doctor regenerator or may be returned to the incoming kerosene stream for reuse.

From the doctor-treating step, the kerosene flows to the acid-treating stage where it is contacted with strong sulfuric acid and then allowed to settle in a settler similar to those used for the doctor stage. The acid settler is followed by an acid-sludge coalescer. This coalescer is a horizontal drum packed with glass wool in which the fine particles of acid sludge, that are not held in the settlers, are separated.

Following the treatment with acid, the kerosene is contacted with natural clay and filtered. This clay treatment removes any traces of water or acid that may be present and brightens the finished product.

Furnace Oil Treater

In order to make a straightrun fraction available as catalytic cracking feed stock, the catalytically cracked gas oil falling in the furnace-oil boiling range is chemically treated to produce a high-grade furnace oil which is of good color, stable, bright and does not have gum-forming tendencies. To accomplish this the catalytically cracked gas oil is acid treated caustic washed, water washed and finally passed through a rock-salt drier to remove any traces of water from the oil. This treatment is carried out continuously through a series of settlers and coalescers similar to those used on the kerosene treater. The oil is first contacted with 93 per cent sulfuric acid which is separated from the oil in a settler and returned to the acid plant for regeneration. The oil leaving this settler passes through a glass wool-packed coalescer to remove all traces of acid sludge. The oil is then contacted with sufficient 2° Be. caustic to neutralize any mineral acid which may be present. The caustic is removed from the oil in a settler and coalescer and drawn to the sewer. The next step in the treatment is with hot water wash carried out in the same manner as the caustic neutralization. The oil is then passed through a rock-salt drier to remove moisture and leaves the treating plant as a bright finished product.

Acid Plant

Sulfuric acid is used as a catalyst in the alkylation units as a selective solvent in the feed-preparation section of the butadiene plant and as a refining agent in the treating units. Each of these departments reject as spent acid, strong acid contaminated with hydrocarbons.

Sulfur-bearing hydrocarbons have a low-octane number and a poor lead response. The worst offenders in this respect are the evil-smelling mercaptans. The treating units are designed to remove mercaptans from the butane-butene fraction and the gasoline fractions. The waste products from this unit's regeneration system are gaseous and liquid mercaptans, and their disposal presents a problem.

Chemical Construction Co. of New York was asked to design a sulfuric-acid plant to meet the following requirements:

1. Produce 350 tons per day of fresh 98 per cent acid.
2. Produce 93 per cent acid for use at the treating units.
3. Dispose of 350 tons per day of spent acid.
4. Dispose of objectionable sulfur-bearing waste.
5. Produce entire capacity from sulfur if desired.
6. Operate at a range between ⅓ and full capacity.

The acid plant as designed will produce 350 tons per day of 98 per cent sulfuric acid from spent acid alone, from a combination of spent acid and sulfur or from sulfur alone. The acid plant will also utilize the sulfur in gaseous and liquid mercaptans for the production of acid.

In order to meet the requirements for flexibility, the acid plant was split into two complete units, each capable of independent operation and with an operating range of from 60 per cent to full capacity.

Each unit has two decomposing furnaces, spent acid and liquid mercaptans are fed into the furnace through a spinning-cup burner and atomized with compressed air. Molten sulfur is sprayed into the furnace. The furnaces are maintained at 2,100° F. using fuel gas and preheated air. At this temperature the acid is decomposed to sulfur dioxide, oxygen and water; hydrocarbons in the spent acid aid in maintaining the temperature in the furnaces. Excess oxygen in the furnaces is held to the minimum that will completely burn the hydrocarbons in order to decompose the sulfuric acid to the maximum extent. Conditions in the furnaces are such that spent acid, mercaptans and sulfur all produce sulfur dioxide either as a product of decomposition or of combustion.

The hot gases from the furnaces are cooled to 1,200° F. in the recuperators where they preheat the air for combustion to 1,700° F. The gases then enter the scrubber towers where cold 40° Be. sulfuric acid is sprayed, counter current to the gas flow. The scrubber acid removes any ash from the gas stream and cools the gases to 200° to 250° F.

From the scrubber towers the gases pass to the cooling towers where direct water sprays cool the gases to 100° F. and saturate them with moisture. The water from the cooling tower is sprayed into a stripper tower, air entering the bottom of this tower and drawn into the cooling tower, strips the water of dissolved sulfur dioxide.

The saturated gases from the cooling towers next pass through Cottrell mist precipitators where any acid mist, from undecomposed acid or formed in burning sulfur, is removed. The two gas streams then merge and go through the drying tower where moisture is removed by circulating 93 per cent sulfuric acid over the tower.

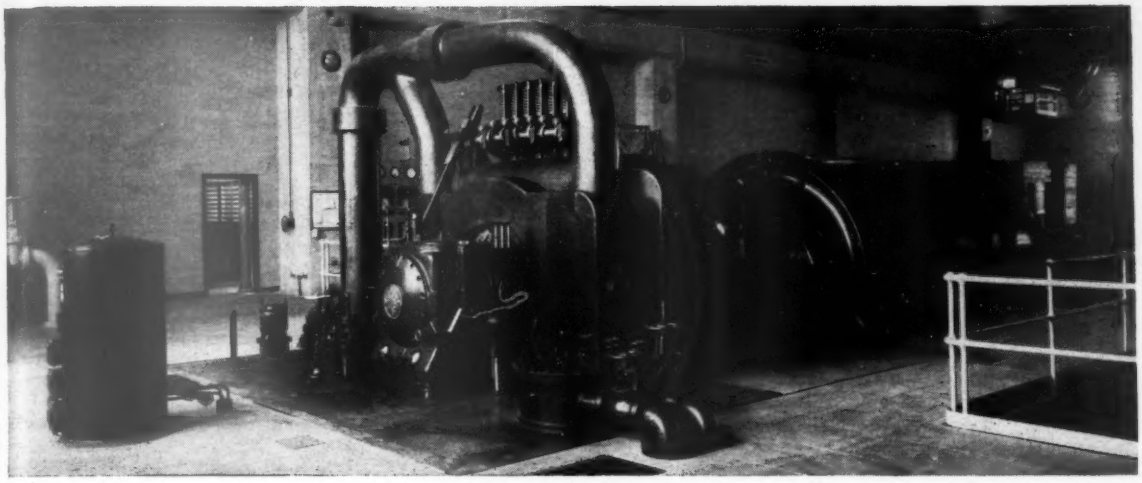
Acid mist and moisture would damage the catalyst masses, consequently they have to be removed from the gas streams. All of the unit handling cool, wet gas is constructed of lead, as wet sulfur dioxide gas is highly corrosive. Dry sulfur dioxide or dry sulfur trioxide gas is noncorrosive, consequently the gas piping in the units, beyond the drying tower is constructed of steel.

Gases leaving the drying tower are drawn into a large blower and discharged into a double heat exchanger where they are heated by the converted gases going to the absorber tower. The gas stream then divides—half going through each of two converter sections which are identical. After dividing, the gas stream is further heated by exchange with the partially converted gas from the primary converter.

The preheated gas enters the top of the primary converter and passes down through two masses of vanadium catalyst. In the converter, approximately 80 per cent of the sulfur dioxide is converted to sulfur trioxide, the conversion is accompanied by the evolution of heat and to complete the conversion the gases must be cooled. The gases are cooled by exchange with the incoming gas stream to the converter.

The gases leaving the exchanger enter the bottom of the secondary converter where they pass down through a third vanadium catalyst mass, here approximately 15 per cent of the dioxide is converted to trioxide, the gases are again cooled by contact with the shell of the converter, the shell is air cooled, then they pass through the fourth vanadium catalyst mass where the remainder of conversion takes place.

Sulfur trioxide gas streams then merge and are cooled by exchange with the sulfur dioxide stream from the blower, the cooled gases then go into the absorber tower where the sulfur trioxide is absorbed by 98 per cent sulfuric acid circulated over the tower; the circulating acid is held at 98 per cent by dilution of the enriched acid and the excess acid is pumped to storage as production.



Turbogenerator in the power house

Power, Steam Generation and Distribution Systems at Lake Charles Refinery

by A. H. Heitzler

AS a component part of the Cities Service Lake Charles basic refinery a power plant was designed to furnish power to the refinery, 18,425 kw.; the butadiene plant, 8,250 kw.; the Firestone synthetic-rubber plant, 4,500 kw., and secondary power to the Power pool of the district, about 12,500 kw. A total of 982,000 lb. per hour of process steam is supplied at 250 p.s.i. to the basic refinery from a low-pressure boiler house and extraction from the 825-lb. main units.

Estimated power requirements of the above plants, 31,175 kw. can be met at all times in the event of failure of one high-pressure turbine, provided that 7,000 kw. of emergency power can be supplied from outside sources.

To care for this contingency a 15,000 kva., 66,000-volt tie to the area Power pool is provided.

High-Pressure Boilers

Two Babcock & Wilcox two-drum boilers are installed. These are designed for 950 p.s.i. and will each deliver 325,000 lb. of steam per hour at 850 p.s.i. and 825° F. total temperature at the superheater outlets.

The boilers are equipped with tubular type air heaters and two-speed induced draft and forced draft fans. Boiler gases are eliminated through a 125-ft. radial brick stack.

A. H. Heitzler was born in San Angelo, Tex., graduated from University of Texas as electrical engineer in 1914, and has been with Cities Service since that time.

The boilers are designed to burn fuel gas or oil but are equipped now to burn only fuel gas. The boilers are located outdoors with only the front enclosed. When burning fuel gas of 1,040 B.t.u. per cu. ft. the efficiency of the boilers is predicted at 79.9 per cent at 325,000 lb. per hour flow. Bailey feed-water regulators as well as complete Bailey automatic combustion control is provided for each boiler.

The feed-water supply to these boilers comes from two sources, main unit condensate and refinery process returns.

Three stages of feed-water heating are provided; low-pressure heaters using steam from thirteenth stage extraction and main unit condensate, deaerating heaters (400,000 lb. capacity each) using 5 p.s.i. auxiliary steam exhaust, main unit condensate and refinery process returns; high-pressure heaters using 25 p.s.i. process steam for heating the predicted final feed-water temperature to 266° F.

Four turbine-driven, six-stage, design-head 2,525-ft. feed-water pumps are provided for feed-water supply to the high-pressure boilers. The high-pressure boilers are equipped with continuous blowdown.

Turbo Generators

Two 25,000-kw., 3-phase, 60-cycle, General Electric Co., parallel flow condensing single automatic turbo generators with direct-connected exciters and pilot exciters are installed. These units are 31,250 kva., 13,800 volt, operated at 3,600 r.p.m. Each generator is equipped with a surface air cooler and automatic CO_2 fire protection. The turbines are designed for 825 p.s.i. 825° F. throttle conditions, 250 p.s.i. back pressure on the extraction section and 1½-in. of mercury at the exhaust of the condensing section.

The machines are unique in that they are really two turbines on the same shaft and in the same shell, one operating as a back-pressure element, and the other as a condensing element. The machines may be operated either by manual or

automatic extraction. Each turbine-oil system is equipped with a Honan-Crane oil purifier and storage is provided in a two compartment 8,000-gal. tank. Provision is also made to treat the turbine oil by use of a DeLaval centrifuge. The turbine room is equipped with a 75-ton traveling crane with a main hook and 10-ton auxiliary hook.

Two 18,000 sq. ft. Allis Chalmers, surface condensers with cast iron shells, water boxes, steady plates and admiralty tubes are installed, one under each main unit.

Pressure Reducing Stations

Pressure reducing stations are provided as follows: 825 p.s.i. to 250 p.s.i. 20,000 lb. per hour; 25 p.s.i. to 25 p.s.i. 60,000 lb. per hour, to protect auxiliary steam header and to utilize refinery exhaust steam in the 5 p.s.i. feed-water heating system. Drips and drains from the 825, 250, 25 and 5 p.s.i. systems are recovered and returned to the deaerating heaters or low-level surge tanks.

The 25,000 kw. generators are connected to the station bus by two 1,750,000 cm. per phase insulated cables in nonmetallic conduits supported under the turbine floor levels. Generator neutrals are grounded through suitable impedances and oil switches. These are located under the generator foundation along with the main exciter field rheostat. Normal operation is with one generator neutral grounded.

The main 13,800-volt bus is located in the electrical bay on the turbine-room level. The bus structure is General Electric cubicle type steel enclosed, rated at 15 kv. There are 19 circuit breakers, 1,000,000 kva. interrupting capacity.

The main bus is divided into two sections closed by a bus-tie breaker. One generator and one auxiliary power bank is located on each section. The 15 power feeders are interlaced on the two sections of the bus to insure the maximum reliability of service. The later installation of the transfer bus mentioned above will increase this factor.

Station auxiliary power of 2,300 volts is served by two 13,800/2,300-volt, 3-phase O.I.S.C., with future air blast transformers. The 2,300-volt bus and switching is metal clad, vertical lift switchgear sectionalized by a bus-tie breaker.

Station auxiliary power of 440 volts is served by two 2,300/440-volt, 3-phase O.I.S.C. transformers.

120/208-volt, 3-phase lighting and power is served by two 75 kva. 440/120/208-volt transformers.

The main power house control board is located on the turbine room level. This board is a General Electric vertical panel duplex switchboard. The necessary instruments and control switches for operation of the generators and 13,800-volt circuits located on the front and the watt-hour meters and protective relays are located on the back.

Circuit Breaker Current

Direct current for the operation of circuit breakers, controls and emergency lighting is provided by a 60-cell Exide battery and a 10 kw. divertor pole M.G. set.

The main power house also contains four air compressors, one steam driven and three synchronous motor driven with a combined capacity of 6,000 c.f.m.

To serve the refinery are two air systems, one for refinery plant air and one for the instrument air. Pressure is maintained on the instrument air system by a P.R.V. at 90 p.s.i. A spill valve is installed in the 110-lb. plant air line to protect the instrument air system.

The butadiene plant has its own 400 p.s.i., 600° F., 500,000 lb. per hour capacity boiler plant. There were two reasons for this: (1) The long transmission distance, and (2) the desirability of 400 p.s.i. steam for process and driver duty.

To provide refinery process steam at 250 p.s.i. above the amount of 250 p.s.i. extraction steam from the turbines, there are installed: Two Riley steam generators having a capacity of 20,000 lb. per hour at 250 p.s.i. 600° F., and four used B & W crossdrum sectional-header boilers, obtained from the Windsor plant of the American Gas & Electric Co., Wheeling, W. Va. Each of these boilers has been set over a newly designed Detrick furnace and will have a steam capacity of 120,000 lb. per hour at 250 p.s.i. and 600° F.

These boilers are equipped with Republic Flow Meter Co. automatic combustion and Bailey feed-water control and are designed to burn either fuel gas or oil. The oil to be burned is an asphalt residue from the desalting and deasphalting unit of the refinery.

Four feed-water pumps, two motor and two steam driven are installed for feed-water supply.

Provision for Expansion

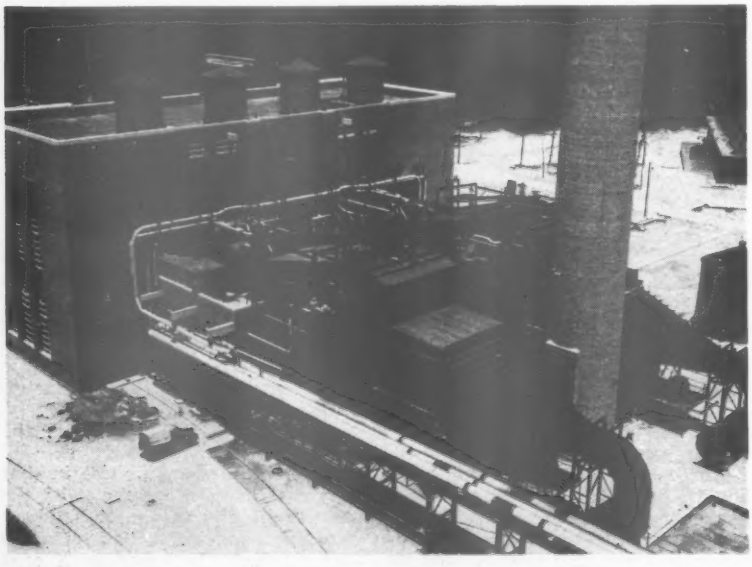
The boilers are set outdoors with one Riley and two B & W boilers on each side of a 20-ft. aisle. Provision is made for expansion and installation of additional boilers at a later date. The boilers are equipped with continuous blowdown.

Since condensate returns are routed in a selective manner which will provide for 100 per cent returns to the high-pressure boilers a large amount of treated water will go to the low-pressure boilers.

To provide for this makeup an Infilco hot-process water-treatment plant has been installed. This system will handle and treat 600,000 lb. per hour of raw well water. The hardness will be reduced to approximately 15 p.p.m. and the silica reduced from 50 p.p.m. to 6 p.p.m. Residual hardness will be removed from the low-pressure boilers by the addition of phosphate fed to the boilers directly. The Infilco system will also heat and deaerate a maximum of 400,000 lb. per hour of refinery condensate returns.

A complete laboratory for water analysis, and water control is provided in the chemical house adjacent to the water-treating plant.

Refinery condensate is delivered to two 5,000-bbl. steel tanks and



Two main (high-pressure) boilers

pumped from them by four 680-g.p.m. motor-driven pumps to the low-pressure boiler plant, water-treatment plant, and the high-pressure plant deaerating heaters.

Fuel-oil storage at the low-pressure boiler plant is provided by two 5,000-bbl. steel tanks equipped with steam heating coils.

U-Shape Design

The steam distribution and condensate return systems were designed in a U-shape with the power plant feeding into the steam distribution system approximately at the center of the U. Steam comes from the power plant through three 18-in. lines carried on a trestle to provide road clearance and at the end of the trestle drops down to the distribution system slightly below ground level in a concrete paved trench. This same trestle in addition to carrying the three 18-in. steam lines, carries a refinery clean exhaust-steam line, a refinery-condensate line, a fuel-gas line and a fuel-oil line to the power plant. Compressed air for general refinery service and instrument air are also carried on this trestle. The concrete paved trench in addition to serving the steam systems, carries fuel gas, natural gas, compressed air and instrument air lines.

The system was designed to distribute nominal 250 lb. gage-pressure steam to all refinery units. The condition of design was that the units at the extreme ends of the system (C_4 recovery and treating plant) were to have steam delivered to them at 225 lb. gage. Yarway expansion joints were used in place of expansion loops to minimize line-pressure drop.

Although the butadiene plant associated with this refinery has its own boiler plant, a 10-in. crosstie line has been provided between the two plants.

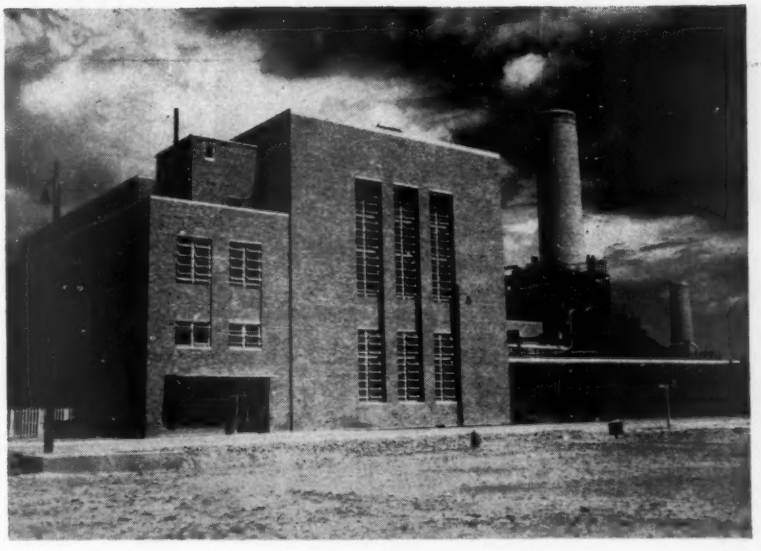
The refinery clean exhaust-steam system and the reciprocating pump dirty exhaust system have been segregated to prevent any oil contamination.

Use of Exhaust Steam

The dirty exhaust steam is used at the catalytic-cracking units and any deficiencies at these units are made up from the refinery clean exhaust-steam system through check valves which open only when the pressure in the reciprocating pump dirty exhaust system drops.

Pressure reducing stations have been provided between the 250-lb. steam-distribution system and the 25-lb. refinery clean exhaust-steam system.

These stations were installed to stabilize pressure and supply any deficiencies in the refinery clean exhaust-steam system.



View of main power plant

There are thirteen 13,800-volt feeders from the power-plant bus feeding the substations. These feeders start at the outgoing terminals of the 13.8 kv. breakers then through 500-amp. reactors to the underground cables.

The 13.8 kv. underground cables are carried from the power plant in an underground-duct system. Fiber conduit encased in concrete is used. The manholes are of reinforced concrete, sufficient in size to provide for splicing and proper racking of the lead-covered cables. The cables are all fireproofed in each manhole to prevent damage to adjacent cables in case of a failure.

Seal Pits Between Manholes

Seal pits are provided between manholes to prevent migration of gas through the duct system and to prevent an explosion from carrying through between manholes. To accomplish this special seal-off, fittings are used in the pit on each conduit to give a gas-tight seal around the cable in the duct.

There are 10 combination power and lighting subs and five lighting subs. Also a tie sub which furnishes a connection into the transmission network in the Lake Charles area.

All of the substations in the basic refinery are furnished with outdoor metal clad switch gear with lift type breakers. The transformers are of the totally enclosed type.

Various precautions have been taken to provide uninterrupted service; some of which are, automatic throwover from normal to emergency feeder at the main substations, duplicate feeders to each station, feed from different bus section in power plant and duplicate feed to important 2,300-volt power loads.

The outside lighting facilities for the refinery may be divided as follows: Fence lighting, street lighting, flood lighting, and the aviation warning beacon.

The fence lighting is fed from four 10 kva. constant current transformers, and the circuits carry 400 candle power 6.6 amp. series lamps.

The street lighting is similar to the fence lighting except that the lamps are 250 candle power and the transformers 7½ kva. There are four series street lighting circuits.

The yard flood lighting system is fed by 2,300-volt circuits with individual transformers at the big flood lighting towers. There are 20 steel towers with two to four 1,500-watt flood lamps, lighting the tank farm, dock areas. The control system consists of small 2,300-volt solenoid operated switches having a 115-volt coil circuit remote control.

The aviation-warning beacon is mounted on top of catalytic-cracking Unit B approximately 230 ft. above ground. This unit revolves and has an automatic lamp changer. The beacon is controlled from the power plant switch board and is turned on and off by the switchboard operator.

Black-Out Control

All flood lights, street lights, aviation beacon, and building lighting can be blacked out from a central switch board. This leaves only the emergency black-out lighting in the buildings. The emergency lights are fed from small turbo generators that start up automatically on failure of normal power. After a black out, it is necessary to reclose the breakers at each lighting transformer and restore lighting service to normal.

MILLIONS of gallons of 100 octane gasoline were required to start the invasion of Europe on June 6th.

The Link-Belt Herringbone Gear Speed Reducer (pictured here) equipped with an explosion proof electric motor, is operating a Kinney rotary transfer pump in one of the largest entirely new 100 octane gasoline plants in the world . . . Cities Service Refining Corporation at Lake Charles, La. It is one of many Link-Belt Speed Reducers now doing a vital job in high octane gasoline plants, synthetic rubber plants, chemical plants and other war industrial plants.

Link-Belt enclosed herringbone gear speed reducing and increasing units are made in three types, 45 standard sizes. Ratios 2.8 to 1 to 318 to 1, 1½ H.P. to 250 H.P. Link-Belt worm gear reducers are made in 7 types, 62 standard sizes. Ratios 3⅝ to 1 up to 8,000 to 1. ⅛ H.P. to 100 H.P. Link-Belt motorized helical gear reducers are available in 16 standard sizes, ratios 6.2 to 1 to 292 to 1, 1 H.P. to 75 H.P. Send for catalogs.

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LINK-BELT SPEED REDUCERS

Butadiene Plant Has Capacity of 55,000 Short Tons Per Year

W. A. BURHOUSE

D. R. McKINNEY

W. A. Burhouse, superintendent of Cities Service Refining Corp.'s butadiene plant at Lake Charles, graduated from Lehigh University in 1933, went to work for Cities Service immediately at Petty's Island refinery. He was transferred as general process foreman to the East Braintree, Mass., refinery in 1939, then in 1942 went to the New York office as refinery engineer, to be chosen in June of that year to his present position.

D. R. McKinney hails from Houston, Tex., and worked for Humble Oil & Refining Co. until 1929. He then joined the Kellogg Co., and since has been active in engineering and operation of refineries for that company in this country and abroad.

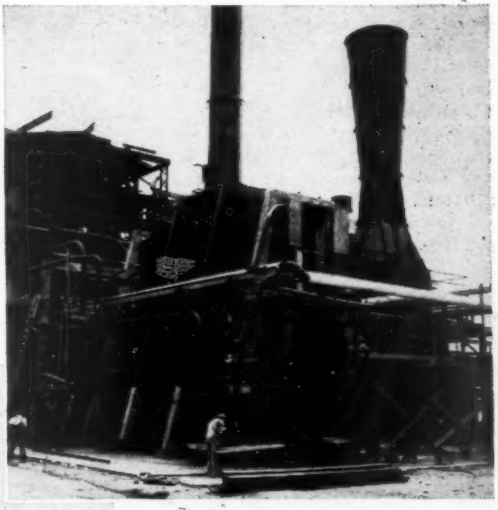
by W. A. Burhouse and D. R. McKinney

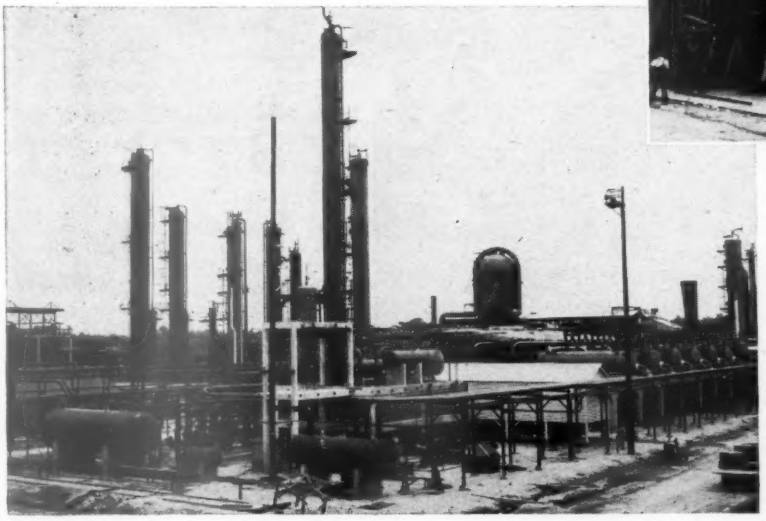
IN connection with the basic refinery at Lake Charles, La., Cities Service Refining Corp. will operate, for Rubber Reserve Co., a plant rated at 55,000 short tons per year of butadiene by the catalytic dehydrogenation of normal butylenes. This plant is an integral part of the Cities Service Lake Charles project and, like the basic refinery, was designed and constructed by The M. W. Kellogg Co. of New York. It is one of the larger single units for the production of butadiene by catalytic dehydrogenation of butylenes in the entire rubber program.

The feed to the butadiene plant is supplied by three catalytic cracking units and a thermal reforming unit in the basic refinery. Feed stock consists of normal butylenes, isobutylene, normal butane and isobutane. Since all of the constituents in the feed are not directly convertible to butadiene in this process, the preliminary operations in the plant are for the purpose of removing these unconvertible materials.

The first step in purifying the feed stock is the removal of isobutylene, by converting it to diisobutylene by reaction with cold dilute acid and subsequent polymerization and separation. The dimer thus produced is returned to the alkylation unit in the basic refinery for processing into aviation-gasoline components. Fresh acid is obtained from the acid plant in the basic refinery, while spent acid from the process is returned to this unit for reclamation.

In the second stage of feed purification, normal and isobutane are separated from the normal butylenes by extractive distillation. The use of an extractive agent in this process is necessary because of the very narrow spread in the boiling points of the butanes and butylenes. This intricate fractionation is carried out in the largest fractionating tower of the entire Lake Charles project, a vessel 13 ft. 6 in. in diameter and 155 ft. high containing 72 bubble trays. The butanes rejected are pumped back to the basic refinery for utilization in the manufacture of 100-octane gasoline.





Above: Butane heaters, in the butadiene plant. Left: Towers and rundown tankage, in the butadiene plant

The purified normal butylenes are charged to the catalytic dehydrogenation reactors where, in the presence of a large volume of superheated steam, the normal butylenes are dehydrogenated to butadiene. The process is one of reaction-regeneration, and is rigidly controlled by an elaborate time-cycle mechanism equipped with interlocks to prevent improper manipulation of

valves. Products from the reaction are cooled by heat exchange, with a large portion of the heat recovered in waste heat boilers and as process heat for the ammonia absorption refrigeration plant described in a subsequent paragraph. The products are finally cooled to atmospheric temperature with cooling water and compressed by a battery of centrifugal compressors. Waste gases are then separated from the liquid product in a conventional gas-recovery plant, while the raw butadiene-bearing liquid produced flows to butadiene purification.

The final step in the production of butadiene consists of extracting the butadiene from the other C_4 hydrocarbons produced in the dehydrogenation reaction, followed by concentration to a purity in excess of 99 per cent. The butadiene is extracted in multistage countercurrent extraction equipment with a special solvent for absorbing butadiene. The extraction is carried out at low temperature by ammonia refrigeration. Butadiene extracted by the solvent is subsequently removed by distillation, water washed, and further fractionated to remove the last trace of objectionable impurities. The butadiene produced is inhibited to retard polymerization. The final product is pumped to the rubber-copolymerization plant operated by Firestone Tire & Rubber Co. for the Rubber Reserve Co., which is located adjacent to the butadiene plant.

Solvent used to absorb butadiene was prepared on the site prior to initial operations. More than 300,000 gal. were prepared which required 275 tons of electrolytic copper shot as well as correspondingly large quantities of other chemicals.

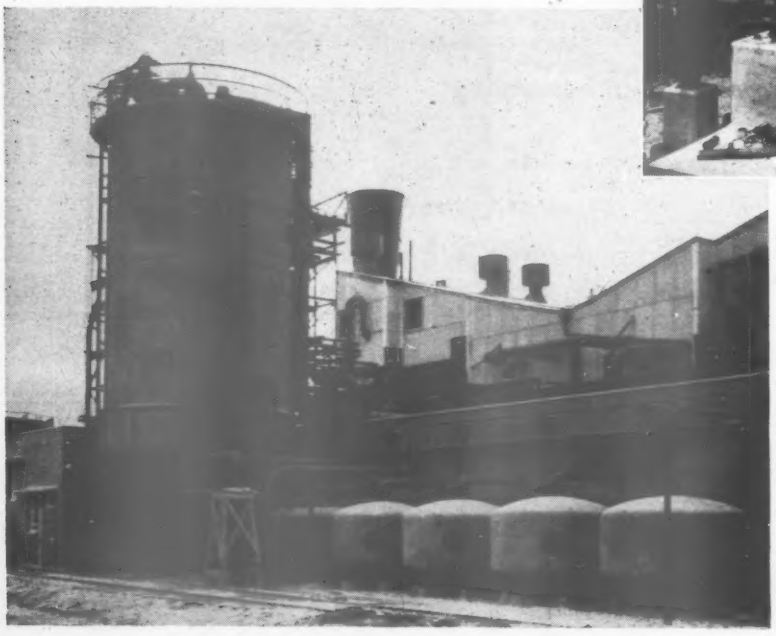
Cooling water for the butadiene plant is supplied through a recirculating system, the warm water returning to two induced draft cooling towers each having a capacity of 30,000 g.p.m. Makeup water for the cooling towers, as well as boiler feed and sanitary water is obtained from three deep wells located within the battery limits. The well water used as makeup is first utilized in several process coolers requiring cold water.

The steam requirements for a plant of this nature are huge, owing to the amount of process steam used in the dehydrogenation reaction. To meet these requirements, the plant is provided with two combination steam boilers and superheaters, each capable of producing 250,000 lb. per hour of high-pressure steam and of superheating steam to high temperature. This steam generating equipment is unique, inasmuch as it is one of the first designs in which a steam generator and superheater furnace are combined into a single unit, with each section separately fired. High-pressure steam from the boilers is first used to drive the dehydrogenation gas compressors and boiler auxiliaries, after which a portion of the steam is used in process heating, while the balance is superheated to high temperature for use in the dehydrogenation reactors. All raw water fed to the boilers is treated with hot lime and gypsum in a boiler feed water treating plant.

The butadiene plant, as designed, requires a large amount of refrigeration, which in this plant has been treated as an additional utility. Refrigeration is provided by a two-stage ammonia-absorption refrigeration plant, which utilizes the waste heat available from condensing steam in the dehydrogenation reactor effluent. There are two levels of refrigeration available with ammonia evaporating at —5° and 45° F.

Complete storage facilities for all feed, product and intermediate streams are provided in eleven 10,000-bbl. and seven 2,500-bbl. spheroids, which operate under a pressure of 15 lb. per sq. in. and are refrigerated to 55° F. Piping between the process unit and the storage area is connected so as to permit a continuous exchange of flowing media between the different sections of the plant.

Electricity for operation of the butadiene plant is supplied by the power plant in the basic refinery.



Above: View of filter. Left: Filters in boiler feed water treating unit, in the butadiene plant

The design and construction was made possible only through the cooperation of Cities Service and Kellogg organizations. Cooperation of interested government agencies: Office of Rubber Director; Rubber Reserve Co.; Petroleum Administration for War and Defense Plant Corp. was of utmost help throughout.

The plant is now in the initial stages of operation and should soon be producing the design quantity of butadiene as its contribution to the war effort.

Subsoil Conditions and Foundations

by C. B. Whyte and Kjetil Haugeto

THE Cities Service refinery is located on the western approach to the Mississippi delta. As a geological formation, this delta is an old sea bottom which has been lifted above sea level and now forms a plateau. This plateau, at the plant site, averages 18 ft. above mean gulf level. Top layers of this plateau are fresh water deposits, while the lower layers are salt-water deposits. Over this plateau, streams and rivers wend their ways, forming valleys and bayous. The Calcasieu River has formed a natural bed 35 to 45 ft. deep, providing a waterway for ocean-going steamers between the plant site and the Gulf of Mexico.

A typical test core from this formation shows first about 2 ft. of top soil, thereafter layers of clay, sand and clay, and fine sand. The clay layers are impervious to water; the clay and sand layers and the fine sand layers carry water.

To determine the load bearing qualities of the soil and the composition of the subsoil, 90 test cores were drilled and 80 load bearing tests were made, distributed over the plant area and especially at the location of the catalytic-cracking units and the power plant. In drilling the test cores, an auger with pipe extensions was used.

Amount of Settlement

Based on investigation and experience with similar soil conditions elsewhere, it was determined that the plant site was good for a working soil-bearing value of 4,000 lb. per sq. ft., 3 ft. below grade. A small settlement of the various foundations is expected in the future as the superimposed loads will squeeze water out of the water-bearing sand layers in the subsoil and cause some consolidation of these layers. As the thickness of the water-carrying layers is practically uniform throughout the plant site, an even settlement of all units is expected. To date, it has been determined that the settlement amounts to about ¾ in. throughout the plant.

Foundations for the plant are designed in accordance with the Joint Standard Building Code, modified by the War National Emergency specifications, and are constructed of reinforced concrete having an ultimate strength of 2,500 p.s.i. and reinforcing steel having a working stress of 24,000 p.s.i.

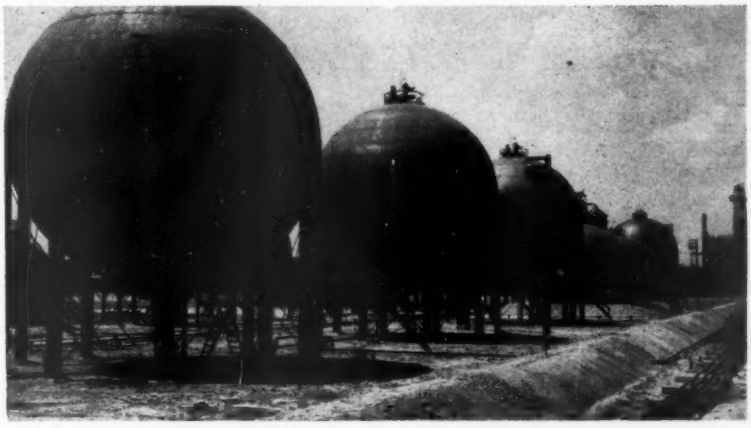
Foundations for tall and elevated structures are designed for the following conditions: wind load, 100 miles per hour, equivalent to a horizontal force of 30 lb. per sq. ft. on horizontal projection of a cylindrical surface, and 40 lb. per sq. ft. on the horizontal projection of a flat surface. A factor of safety for overturning due to wind load of 2½ was used for operating conditions and

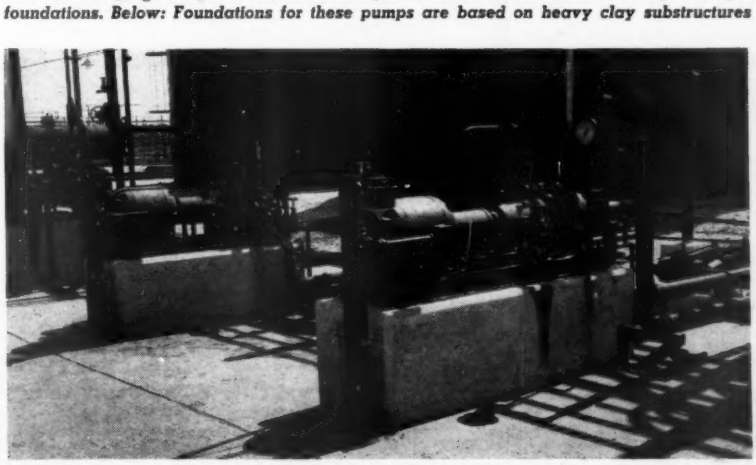
C. B. WHYTE

KJETIL HAUGETO

C. B. Whyte, chief plant engineer for Cities Service Refining Corp., was granted the bachelor of science degree in electrical engineering and mechanical engineering by Georgia School of Technology in 1925, and has been with the Cities Service organization since that date. He has been in succession chief engineer of the refining division, Arkansas Fuel Oil Co.; general superintendent of Defense Plant Corp. at Little Rock, and has been resident engineer during construction of the present plant at Lake Charles.

Kjetil Haugeto was born in Norway and graduated from Norwegian Institute of Technology in 1926 as electrical engineer. He joined M. W. Kellogg Co. in 1926, and has been chief field office engineer for Kellogg on the Cities Service Refining Corp. job since October 1942. He is married and has three sons.





Above: The great weight of these Hortonspheres must be distributed evenly on rigid foundations. Below: Foundations for these pumps are based on heavy clay substructures

1½ for erection conditions. Foundations supporting vessels are designed for: (1) test condition (water-filled vessels with no wind load added): (b) operating conditions (normal operating load of vessels plus wind load), and (c) erection conditions (minimum shipping weight plus wind load).

To conform with war regulations, a number of elevated platforms and supports were built of reinforced concrete instead of structural steel.

In order to eliminate vibration, foundations for slow-acting piston pumps and centrifugal pumps have a ratio of equipment weight to foundation weight of 1 to 3. Crank and flywheel pumps and compressors have a ratio of equipment weight to foundation weight of 1 to 5. Foundations for the 25,000-kw. turbo generators in the power house were investigated for harmonious vibrations due to moving parts in the generators and turbines. All equipment foundations are separated from floor slabs and adjacent structures by strips of mastic to avoid transmittal of vibration to adjacent structures.

To avoid differences in settlement of important structures in the catalytic-cracking unit, these foundations were built in two main groups: Group 1, a heavy continuous slab supporting the reactor and the regenerator structures; Group 2, a heavy continuous slab supporting the fractionator and the electric precipitator structures.

Top soil was removed from the area underneath storage tanks and back-filled with an average of 2 ft. of firm sand.

Earthen firewalls are provided around the storage tanks. The volume inside the firewalls equals one and one-half the storage capacity of the storage tanks. A minimum of 1½ ft. was added to the height of firewalls to allow for compaction of the soil.

A barge wharf for handling barges of solids was constructed on the Calcasieu River with 33 to 45 ft. sheet piling on the water side with one-third of the piles in the subsoil.

A barge wharf and two ship wharves were also constructed and are of wooden construction. Creosoted lumber with 18-lb. retention was used for dolphins, piling, pile caps, braces and flooring. The piles for the ship wharves are 60 ft. long with one-third (20 ft.) of the length of the piles embedded in the subsoil. The barge wharf is of similar construction.

The river bottom at the barge wharf and ship wharves consists of layers of firm clay. The steel sheet piles for the barge wharf were driven to refusal. The wooden piling for the ship wharves was driven to 20-tons capacity.

To provide a gage on the enormity of the job, here are some of the quantities used to build this plant: 1,503,000 cu. yd. of soil were excavated and moved by hydraulic dredging; 800,000 cu. yd. of soil were excavated and moved by dragline, clam steam shovels or by hand; 150,000 cu. yd. of concrete were poured in foundations, underground water tunnels and in road beds; 3,500 tons of reinforcing steel were bent and placed in foundation forms; 12,000 tons of structural steel were used; 4.5 miles of concrete roads, 10 miles of shell roads, were built; 14 miles of railroad track were laid.

The first problem encountered in the undertaking of building this plant was the clearing and drainage of the plant site and building suitable roads for moving material. Considering the heavy Louisiana rains, this first problem proved to be a difficult one owing to the 2½ ft. of top soil on the plant site. This layer of top soil absorbs water and since it rests on a heavier layer of impervious clay, it forms a treacherous surface on which to move heavy equipment. Fast moving winch trucks ready for service were necessary at all hours for the purpose of rescuing equipment "stuck" or buried in soft mud.

STACEY BROTHERS WET SEAL GASHOLDER

for Butadiene Storage at Lake Charles, La.

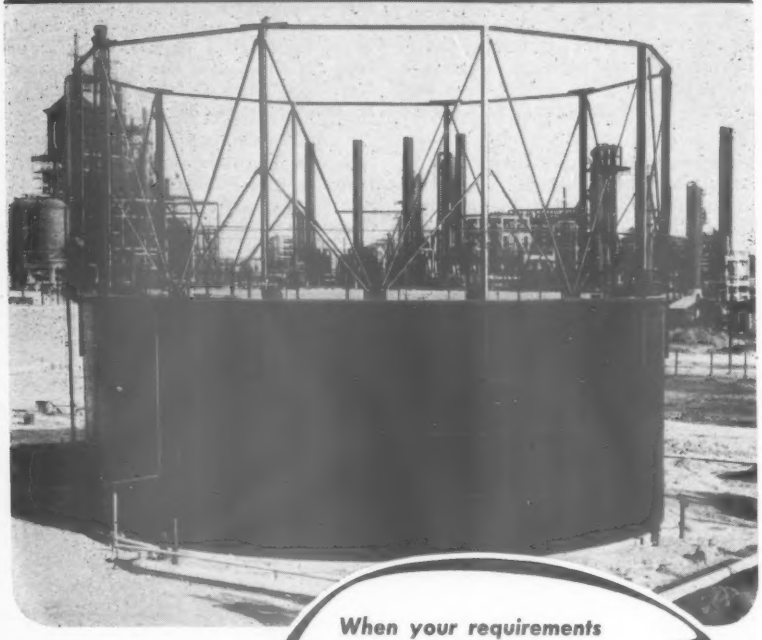


Photo shows a Stacey Bros. All-Welded Panel Design Wet Seal Holder for Butadiene storage in one of the world's largest 100-Octane and Butadiene Plants at Lake Charles, La. Capacity 100,000 cu. ft.

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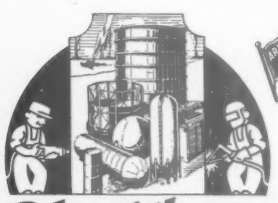

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Water Systems at Plant Supply Steam, Process, and Personnel Requirements

by E. H. Roy

IN the refinery proper the following water systems have been provided: (1) River water or process water, (2) well water for general purposes and boilers, (3) drinking water, and (4) water for fire protection.

The following return systems operate in conjunction with the above: (1) Process water return, (2) oil and water sewer, and (3) steam condensate return.

All cooling water required for condensers and coolers is taken from the Calcasieu River.

The present water requirements of the refinery are 206,000 g.p.m. of which 42,000 g.p.m. are for the condensers in the power station.

What this amount of water means can be more readily visualized when it is considered that this is sufficient water to furnish a city of 3,250,000 population or the residential and suburban districts of Chicago.

For pumping this process water there are fifteen 11,000 g.p.m. Layne & Bowler Co. turbine type centrifugal pumps driven by 500-hp. motors. Four 10,250 g.p.m. Pomona Pump Co. vertical two-stage centrifugal pumps driven by 435-hp. horizontal Terry steam turbines are provided as spares.

These pumps are connected to four 48-in. interconnected headers, each header leading to a 48-in. line. These four lines form a process water-supply system furnishing cooling water to all process units.

The circulating water for the condensers in the power house is furnished through 30-in. line from pumps also located in the pump house. There are three 21,000 g.p.m. 19-lb. Pomona vertical pumps 30-in. single stage, turbine type, two of which are driven by 300-hp. horizontal Terry steam turbines.

Also located in this pump house are two of three fire pumps each being 1,000 g.p.m. 150-lb. Pomona pumps being driven by 120-hp. Coppus Engine Co.'s vertical type steam turbines.

Edward H. Roy, born in Indiana, received both the bachelor degree and that of chemical engineer from Purdue University. He started work with Cities Service back in 1917, went into the first World War, and since then has served in practically every Cities Service refinery, has been plant superintendent of those at Gainesville, Tex., and East Chicago, Ill., before joining the staff as general superintendent at Lake Charles.

Above: Oil-separator vats

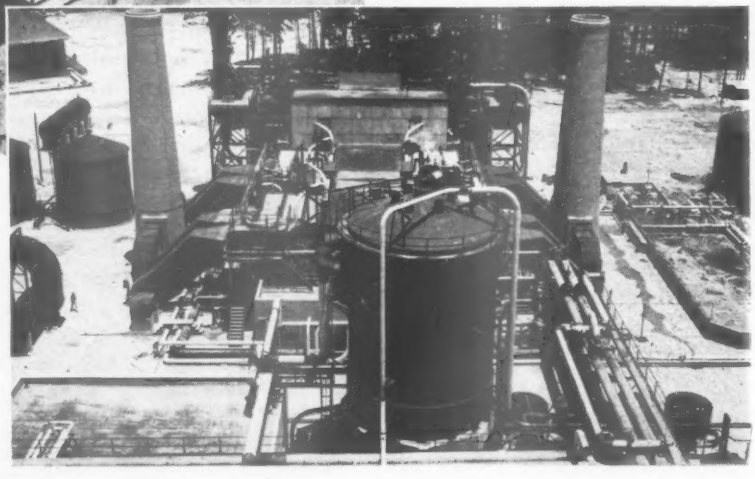
The water intake which is located at the upper property line on the river has intake openings on two levels, minus 13 ft. and 20 ft., choice of level being dictated by water temperature or salinity.

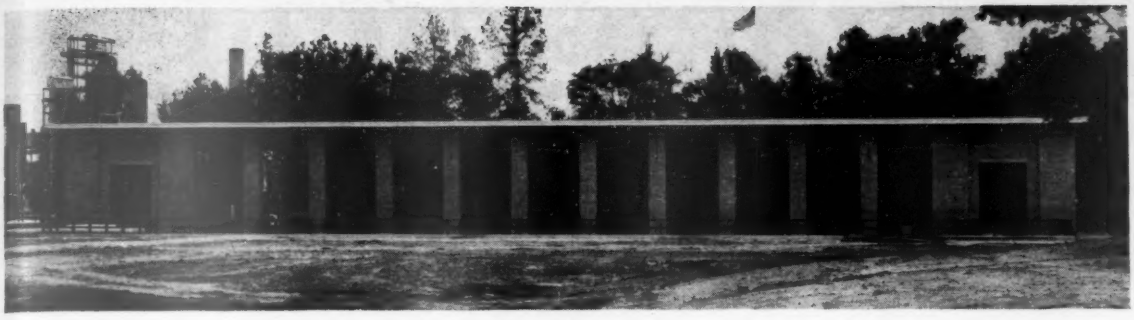
From this intake which is equipped with rotary screens the water flows through two 8 by 8-ft. concrete ducts to the 30 by 206-ft. river-water pump house.

Well Water System

Well water is used for boiler-feed makeup, for drinking purposes, and for supplying fresh water to tankers. The water is drawn from a water bearing stratum at a depth of 500 ft. by three Layne & Bowler deep well pumps. Each well has a capacity of 1,500 g.p.m. at 75 lb. pressure. Two are connected to vertical mo-

Below: Water-treating unit, with low-pressre boilers in background





View of the water pump house

tors and the third to a 150-hp. Murray vertical steam turbine.

The three pumps discharge into a common header which is connected to a 100,000-gal. elevated storage tank.

This well water is piped to all units of the plant as well as to the boiler plant feed-water treating system.

From this well water system is taken a header to the laboratory where the drinking water for the plant is chlorinated and then passed to the drinking water system.

Fire Protection System

The water system for fire protection is separate from any other water system. The basic plant fire system has been interconnected to the butadiene plant through an 8-in. header. Besides the two steam fire pumps in the main water pump house there is an electrically driven fire pump at the southwest part of the plant taking suction out of the holding basin.

The process water return and the surface drainage are combined into one system. This return duct consists of two rectangular tunnels running parallel 8 ft. wide and 8 ft. high.

Branch sewers empty into the tunnels. These branches collect all the plant cooling water and all surface drainage which is free from oil. The outlet from the duct is designed so that any oil which may have found its way into the hot water return system will be trapped.

The circulating water return from the condensers in the power station is returned in a separate sewer to the river.

Settling pond in the water system

Oil Sewer

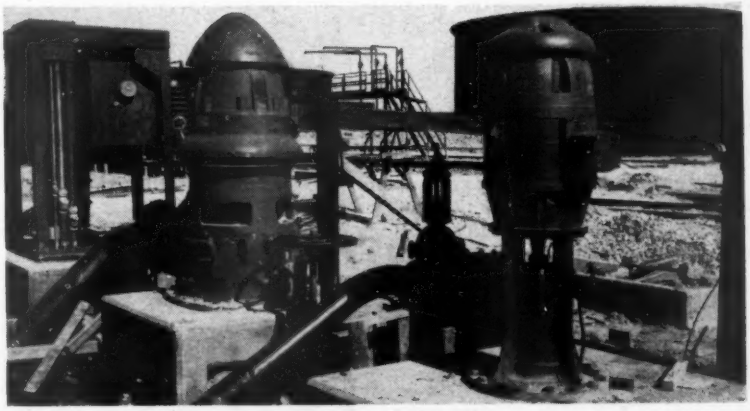
Oily waste water and pump cooling water as well as surface drains within a process area together with all tank water drawoffs are collected in a separate sewer system draining to the main oil sewer which finally reaches a size of 60 in. at the oil separator, designed in accordance with A.P.I. recommendations, having over-all dimensions of 152 ft. long by 137 ft. wide.

Settling Pond

Both the hot process water return and the oil separator flow into a settling pond which is provided in order to trap any oil which may escape from the oil separator or hot water return skimmer.

The main outlet from this pond is into the Calcasieu River about ¾ mile downstream from the water

(Continued on page 129)



View of water pumps

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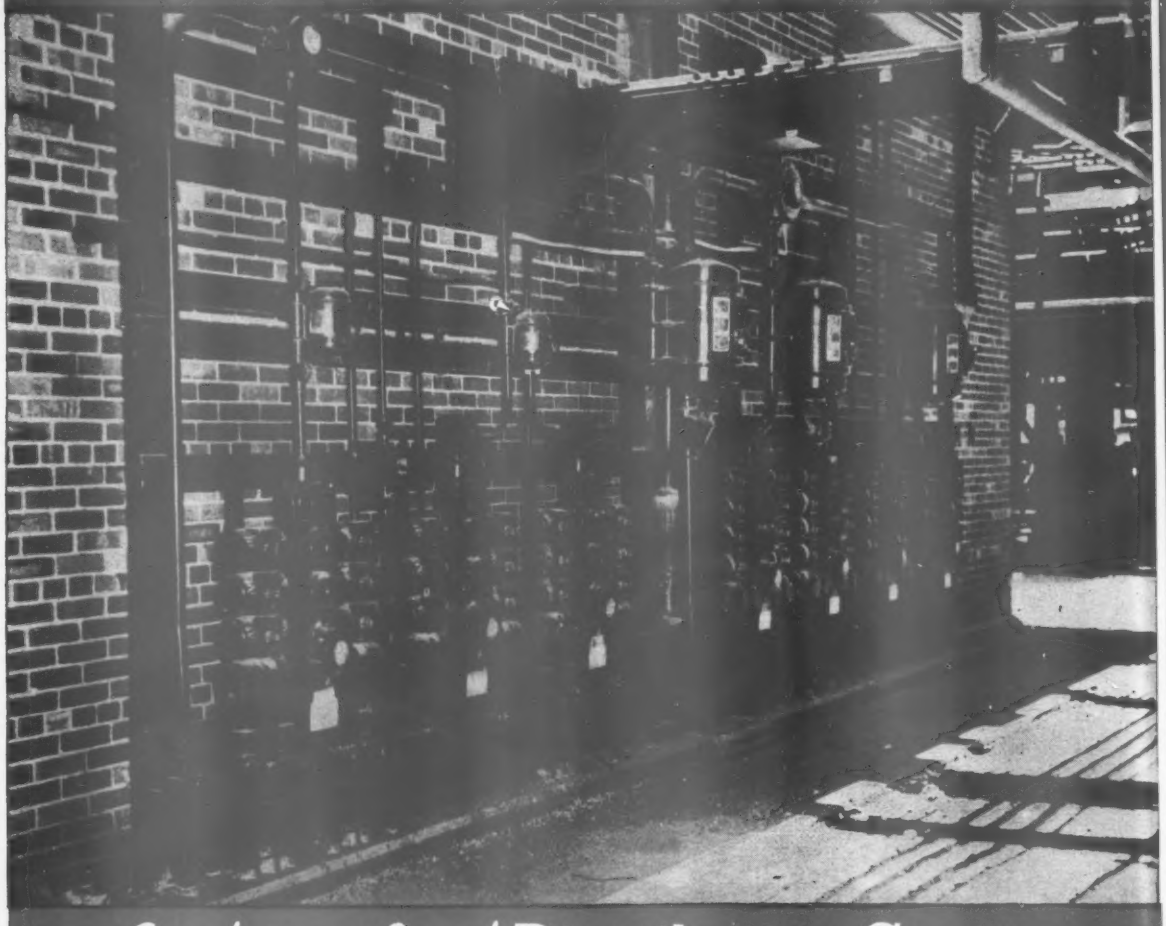

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Convenient Control of Electrical Circuits

This distribution center is a typical field assembly located in an aviation fuel refinery and butadiene plant. It consists of seven Crouse-Hinds Type EDP explosion-proof panelboards, protected by main circuit breakers housed in explosion-proof Type EPC Condulets. Convenient control of one hundred lighting circuits is centrally located at this distribution point

The plant is equipped with a large number of similar distribution centers controlling both lighting and power. Some of these distribution centers were assembled on the job and others were fabricated by Crouse-Hinds Company and shipped complete, ready for installation.

Crouse-Hinds Company's experienced engineering staff and complete manufacturing facilities are available for design and fabrication of lighting and power distribution centers, built to meet field specifications. Equipment designed for all classes of hazardous locations, corrosive atmospheres and exposure to the weather can be furnished.

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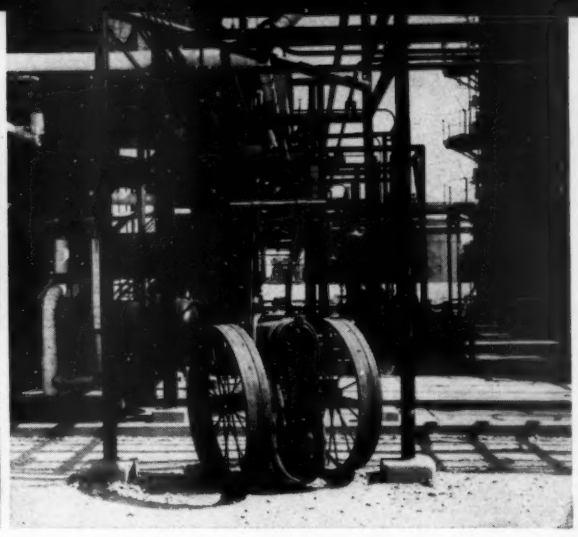

Left: Carbon dioxide fire truck, part of the plant's fire-protection system. Right: Firefoam hand trucks are placed at strategic points

Safety, Guard, and Fire Departments Work as Units in Plant Protection

by J. B. De Laune

PLANT protection at the Lake Charles refinery and butadiene plant, consists of the safety, guard and fire departments, each being essential from a standpoint of efficient administration. The plant protection superintendent has the responsibility of supervising and coordination the activities of the three departments, to assist the plant management in securing adequate protection for the basic refinery and butadiene plant.

The safety department consists of a safety engineer, 2 assistants, 7 senior and 17 junior safety inspectors. The safety engineer has complete charge of the safety program for both plants, submitting all reports and recommendations to the plant protection superintendent.

The safety engineer has an assistant in the basic refinery and also in the butadiene plant, both of these men reporting directly to the safety engineer. General duties of the safety engineer and his assistants consist principally of accident prevention, organization of area safety committees, and supervising the inspectors in their duties.

J. B. De Laune was born in Louisiana, lived in Shreveport until 1943, attending school at St. John's College there. He was employed by Arkansas Fuel Oil Co. in 1930, and joined Cities Service Refining Corp. in July 1943.

Hand trucks placed near turbines operating high-speed pumps

The safety department maintains one senior and three junior inspectors at the basic refinery at all times. In the butadiene plant one senior and two junior inspectors are on duty on each shift 24 hours a day.

The safety department also prepares a monthly summary of accident causes and issues recommendations for their correction. Records and costs of all injuries are maintained together with the frequency and severity of all lost-time accident cases. Each month the Rubber Reserve Co. requires statistics from the butadiene plant regarding all injuries.

The central safety committee comprised of all department superintendents and plant management meets once monthly, or upon call from any member to discuss and advise management of any unsafe

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all-metal thermometers are used at critical checking points!

● At this new Cities Service refinery the familiar, legible faces of WESTON temperature gauges appear at hundreds of critical checking points. Here, too, their selection was based not alone on the extreme legibility of their boldly marked gauge-type scales, but also on their *proved* all-metal temperature principle. This all-metal construction contributes extreme ruggedness, of course; but it also enables these thermometers to maintain their high initial accuracy *far longer* . . . because of the absence of gases, liquids, capillaries, and other troublesome parts.

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practice and to recommend correctives. The plant also has a safety production suggestion award each month.

The safety department issues all hot work releases, for welding or burning in any restricted area. Each location requiring this permit is carefully inspected for any concentration of an explosive mixture before allowing the work to begin.

Preinduction classes in safety company policy, rules, etc., are conducted by this department as well as to train each employe in first aid.

The fire department consists of 22 men, fire chief, 6 captains, 6 lieutenants and 9 firemen. This personnel is divided between the refinery and butadiene plant to provide adequate protection to each.

In the refinery this department has one fire truck equipped with a 500-gal.-per-minute pump and supported by additional marine pumps. Throughout the refinery and butadiene plant, first aid fire fighting equipment has been permanently installed in each unit and area. For the protection of storage tanks permanent foam inlets have been placed on each tank. For a reserve supply of foam approximately 178,000 tons is stored in the refinery.

At the Ethyl blending plant a fog spray fire protection system is installed in the lead blending room and over all outside tanks.

To furnish adequate protection for two 25,000-k.v. turbines situated in the power house an automatic CO_2 system has been installed, which consists of an initial bank of six 50-lb. drums, and a delayed bank of eight 50-lb. drums.

The fire mains are independent of the plant water system, yet they are insured in every possible manner against a drop in the water pressure. A constant 65-lb. pressure is maintained at all times on the fire system. If a fire occurs, two 1,000-g.m.p. pumps with 100-lb. pressure, used for fire supply only, are turned into the fire mains. Together with the water system both plants maintain a hookup in which this department can get the maximum water volume and pressure of each or both plants, also utilizing the men and equipment of each plant as a single unit.

The butadiene plant is protected by a 3-ton Cardox (CO_2) truck, in addition to adequate first aid fire equipment in each area.

The guard department has the following personnel, a chief, 6 lieutenants, and approximately 80 guards. These guards are divided between both plants to give 24-hour protection to each.

All guards are sworn into the Auxiliary Military Police and receive a 54-hour course of instruction in police and guard activities. Each man receives individual schooling in the use of firearms.

Water Systems at Lake Charles Plant

(Continued from page 125)

intake. It is provided with a skimming apparatus and pump.

Condensate Return

Another water return system throughout the plant is the condensate return. All condensate from heating coils and turbines is collected. The high-pressure boilers are fed entirely from the condensate return. The low-pressure boilers being fed in part from this return condensate the balance from well

Marley water-cooling towers showing induced-draft fan housings

water which has first been treated by an Infilco water-treating plant capable of handling 600,000 lb. per hour.

Butadiene Plant

The butadiene plant contains the following water systems: (1) Cooling water system, (2) well water, (3) drinking water, and (4) water for fire protection.

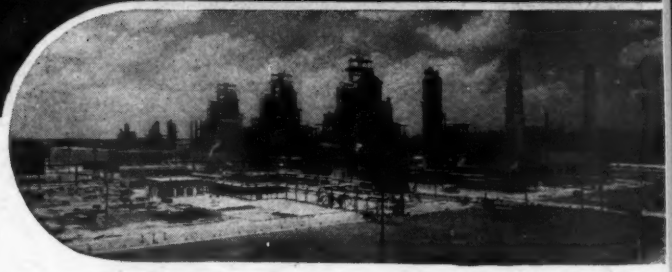
The following return systems are provided: (1) Cooling water, (2) oil sewers, and (3) condensate return.

Cooling Water

The butadiene plant being located much farther from the river, it was considered feasible to use cooling towers rather than pumping river water such long distances.

The cooling water system consists of two induced draft cooling towers

R-S Valves
Installed in
Cities Service New Plant
Lake Charles, La.



This new 100-octane gasoline and butadiene plant, now operating deasphalting, desalting, topping and cracking units, will produce daily enough high-octane gasoline to power a raid of 1000 bombing planes over Germany. Butadiene for more than 12 million synthetic rubber tires will be turned out each year.

R-S Butterfly Valves are a "natural" wherever simplified and quick control or shut-off of volume and pressure are required. (Remember that four to six revolutions of the handwheel completely open or close an R-S valve vane.)

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A typical example of the R-S valves installed in the plant is this special 36-inch valve with welding end. It has a chrome-moly vane, carbon-moly body, alloy shafts and bushings, finned lubricated stuffing box and is powered by hydraulic cylinder with positioner. The auxiliary heavy-duty handwheel control is equipped with self-locking worm and gear. Declutching unit permits manual operation in case of power failure.

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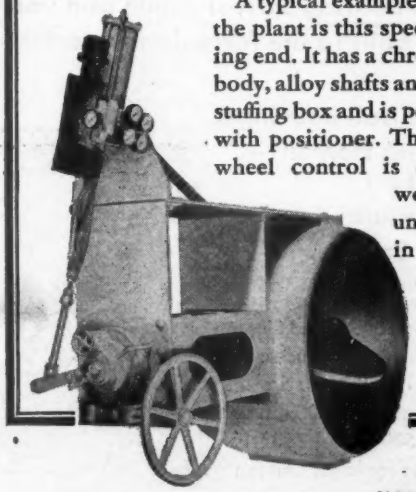

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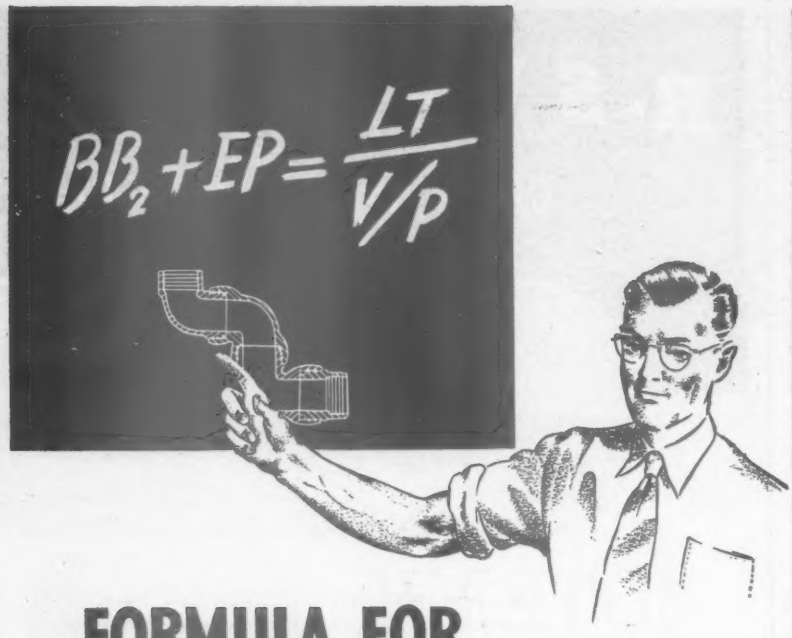
R-S Streamlined BUTTERFLY VALVES



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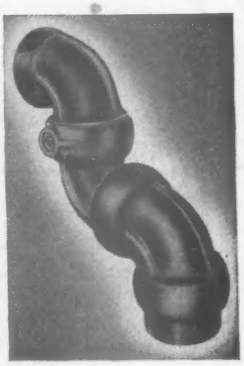

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approximately 300 ft. long. Each tower has a circulating capacity of 30,000 g.p.m. and the basins under the towers have each a holding capacity of 900,000 gal.

Each cooling tower pump house has three 9,000 g.p.m. 70-lb. Pomona vertical multistage turbine type pumps powered by 400-hp. synchronous motors. The pumps from each pump house discharge into a separate 36-in. reinforced concrete pipe system which connects at the other end of the plant thus forming a loop water supply system with a capacity of 54,000 g.p.m.

Well Water

To provide the makeup for the cooling-water system, as well as for the boilers and drinking water, there are three wells. Two of these pump water from a 700-ft. stratum and one from a 500-ft. depth.

These wells are equipped with 1,500 g.p.m. vertical centrifugal turbine type pumps each driven by a 150-hp. motor. The boiler water is treated in an Infilco hot-water softener of a capacity of 1,000 g.p.m.

Drinking Water

The drinking water system throughout the plant is a separate system coming from the 500-ft. well through a Wallace & Truman chlorinator.

Fire Protection System

In each circulating water pump house there is provided one 750 g.p.m. 150-lb. turbine-type pump discharging into an 8-in. fire main. These mains join at the far end of the plant thus forming a complete loop system. This fire system is also crossconnected with the basic refinery system and the Firestone plant.

Cooling Water Return

The cooling water return system of the butadiene plant consists of 36-in. concrete pipe returning the water to the top of the cooling towers. The overflow from the tower basins goes into the oil separator before leaving the plant.

Oil Sewer System

An oil and water sewer system is provided for catching all surface drainage from the unit area and all pump cooling water and equipment drains.

This system is made of vitrified tile and empties into a water separator of the usual design.

Condensate Return System

The butadiene plant also has a condensate return system. It gathers all condensate from the reboilers steam traps, returning about half the steam generated as condensate return.

Radiographic and Magnetic Inspection Reduces Equipment Failure

by E. H. Short, Jr.

The shortage of materials, mechanical equipment, and the forced use of inadequate alloy steels has caused the oil industry to adopt methods of inspection which were first introduced and proved satisfactory in the airplane and shipbuilding industries. First of these methods adapted to the oil industry was the Magnaflux, which was described in the December 9, 1943, issue of The Oil and Gas Journal. This article deals with other methods of nondestructive inspection which have gained wide acceptance in a relatively short period of time.

UNTIL comparatively recently, the economic life of various types of oil-field equipment was determined altogether either by visual inspection or through the analysis of operating records, or through the use of a combination of the two methods.

Many companies adopted set policies designed to govern the replacement of various types of equipment. These policies were formulated after an analytical study of the operating history of the various types of equipment. Through the replacement of equipment after a predetermined number of failures, it has been possible to reduce the excessive repetition of costly equipment breakage. Notable examples of the equipment to which this system has been applied are drill pipe, tubing, sucker-rod couplings, sucker rods, etc.

Many companies are now finding that through periodic radiographic or magnetic inspection, equipment may be operated safely over longer periods of time. Since the economic life of equipment under the old system was of an arbitrary nature, a large safety factor was necessary, and this resulted in equipment being taken out of service prematurely. Such equipment usually was assigned to lighter-duty work, and very often some of it (as breakage later indicated) was not adequate for the lighter job to which it had been assigned.

Failure of equipment due to causes other than fatigue are often prevented by means of radiographic inspection. Many manufacturers are using this type of inspection on castings before the machine work is done, thus saving the machine time which would otherwise be wasted if defects were found a short distance below the surface during the machining operation. These manufacturers feel that the radiographic method of inspection is superior to the conventional hydrostatic test to which valves, christmas-tree connections and pressure vessels are subjected as a final test. A piece of equipment might withstand the hydrostatic test and still fail through a hidden defect after only a short period of operation. Such failures are due to the action of corrosion or erosion, or a combination of the two, in the vicinity of a defect which did not show up during the pressure test. Even in cases where high-pressure equipment goes on the job with no defects at all, extremely bad conditions of corrosion and erosion might seriously weaken the equipment, and for this reason some operators have had such equipment tested to minimize the possibility of a dangerous failure.

Ferromagnetic Particle Inspection

The inspection of oil-field equipment by means of the magnetic method involves the induction of a magnetic field into the equipment under examination. This is done by means of a 4,500-amp. 6-volt d.c. Magnaflux unit shown in Fig. 1.

The theory involved in magnetic inspection is relatively simple. When a piece of equipment, such as a drill collar, kelly, walking beam, or joint of drill pipe is magnetized, any defects (such as microscopic fatigue cracks) become magnetic leaks. If a defect is parallel to the lines of mag-

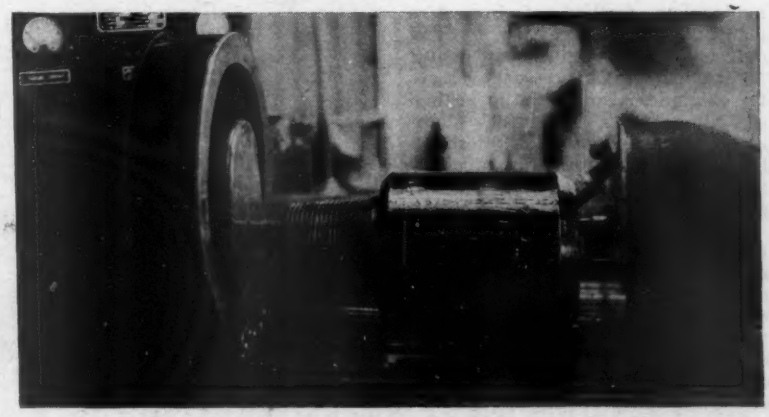

Fig. 1: A 4,500-amp. magnaflux unit, with tool joint receiving electrical charge

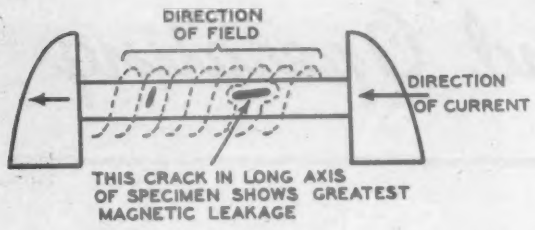

Fig. 2

netic force, the escaping leakage is reduced. Therefore, it is necessary to magnetize and inspect the metal both circularly and longitudinally. Fig. 2 illustrates a circular magnetic field, the points of contact being at the ends of the material under inspection. This type reveals cracks or defects in the long axis. By placing the part to be examined in a coil, as shown in Fig. 3, a longitudinal field is created, which reveals circumferential defects. Where the inspection of heavy or bulky equipment is involved, instead of putting it in the machine, the magnetic field is created by prod contact as shown in Fig. 4. To bring out defects in this type of equipment, a fine powder of ferromagnetic particles is blown or dusted on the magnetized area which is attracted to the fields of leakage if any happen to be present.

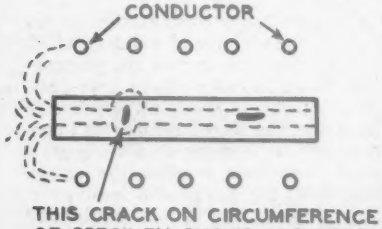

Fig. 3

Magnaglow Method in Inspection

Many companies have found the magnaglow method of inspection particularly valuable for locating defects inside of equipment—valve bodies and small pressure vessels, for example. Also for the inspection of pump parts, cylinders, motor blocks, gun-perforator firing chambers, sucker-rod couplings, and numerous other similar items of oilfield equipment.

The magnaglow process of inspection is very specialized, and is the most recent development in the field of magnetic inspection. The same magnetizing procedure as used in the dry process is employed in the magnaglow method. The part to be examined is placed in the machine and magnetized. While the current is being applied, instead of blowing ferromagnetic particles over the equipment under test, the ferromagnetic particles are contained in a kerosene vehicle which is automatically poured over the specimen. The particles in suspension are attracted to the magnetic leaks. The specimen or material under inspection is then taken to a dark room and placed under a mercury vapor lamp equipped with a deep purple filter lens. Under this light the sound metal appears deep purple, and any ferromagnetic particles which align themselves to the microscopic defects appear gold. This method of inspection is rather spectacular. In the darkened room the parts are bathed in a dull violet glow of light. These same parts or piece of equipment which appeared perfect to the eye a few moments before the magnaglow procedure was begun, appear to be covered with fine lines of gold which indicate invisible fatigue cracks.

Radiographic Inspection

Radiography with radium is being used extensively to discover defects in many different types of equipment used along the Gulf Coast, such as high-pressure vessels, piping, separators, catalytic-cracking units, casing heads, high-pressure valves and all types of connection work. Several companies in the Houston area have experienced pressure failures in christmas-tree connections which convinced them that periodic inspection by means of radiography is a safety procedure which cannot be ignored.

The use of radium to discover "hot tears," blowholes, and coarse porosity in weld metal, is a simple and convenient process. The work can be done in the Precision Inspection Service Laboratory in Houston, or the radium may be sent out with an operator to photograph the interior of equipment on location. The method of photographing the interior of rough casting is shown in

Fig. 4: Prod method of contact used on large, bulky pieces of equipment in the Precision Inspection Laboratory at Houston

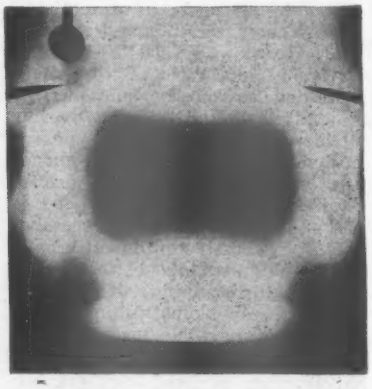

Fig. 6: Gammagraph of studded tee—pencils point to defects inside casting which caused tee to fail on a high-pressure well

Fig. 5: Castings arranged in circle 36-in. from radium (see radium holder in center) preparatory to making Gammagraphs

Fig. 5. The manner of placing the film behind the portion of the casting to be inspected or photographed is indicated by the casting marked with an arrow. The portion of the casting to be photographed, or Gammagraphed, is approximately 3 in. in thickness. The castings are approximately 36 in. in from the center location of the radium capsule.

Fig. 6 is a Gammagraph of a studded tee which failed in operation. This piece of equipment had passed the usual hydrostatic test and failed after the defect had been opened by the combined action of corrosion and erosion.

According to B. J. Kalb, manager of Precision Inspection Service, these nondestructive methods of inspection are not confined to their laboratories; since the practical need for inspecting equipment on location has made it necessary to provide portable means for performing both radiographic and magnetic inspection work in the field.

George L. Kirk, who was manager of West Texas Gas Co.'s office at Floydada, Tex., has been made manager of the company's Midland, Tex., office. He has been with the company 16 years.

Joe Kornfeld, metallurgist, of Houston, former oil editor of Wichita (Kans.) Beacon, has joined the petroleum engineering staff of The Texas Co. in Fort Worth.

First Lt. Stuart Nixon, formerly on the export sales staff of Tide Water Associated Oil Co., has been awarded the Silver Star for gallantry while fighting against the Japanese on New Britain. Nixon was cited for directing artillery fire to within 50 yards of his position as forward observer and under withering fire, thwarting five critical attacks by the Japanese. This artillery support, according to the citation, spelled the "difference between victory and defeat."

Gilbert Morales, of Vera Cruz, Mexico, a graduate of University of Oklahoma, has joined the geological staff of Phillips Petroleum Co. in Oklahoma City, after being employed for several months at the company's headquarters office in Bartlesville, Okla.

W. Brantley Jackson, Magnolia Petroleum Co., is president of the newly organized Mississippi Landmen's Association, at Jackson. **C. M. Fidler,** Tide Water Associated Oil Co., is secretary-treasurer.

Capt. K. M. Regan, recently released from the Army Air Force, has reentered the oil business as an independent operator in the West Texas area, with an office in Midland. Captain Regan, after serving a term as state senator, 1933-37, while a resident of Pecos, joined Salt Dome Oil Co. at Houston. He maintained that connection until 2 years ago, when he entered military service.

Charles K. Slack, assistant treasurer of General Petroleum Corp. of California, was elected president of Petroleum Accountants Society, Los Angeles, last week.

John C. Cramer, who was supervising inspector at the Baltimore refinery of Standard Oil Co. of New Jersey before he entered military service, has been promoted to lieutenant colonel at the Allied headquarters, London.

L. S. Reed, formerly vice president of Texas Gulf Producing Co., was elected president at the annual meeting in Houston.

C. A. Breen, formerly assistant manager of the New York division of Colonial Beacon Oil Co., has returned to the management of Sylvestre Oil Co. He recently was elected president of the latter organization.

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Oil-Well Pumping Practices—No. 39
Methods for Prevention and Removal of Paraffin Deposits

by J. Zaba

IT has been stated in the preceding installments of these series that the most commonly occurring causes of need for reconditioning of the producing wells can be grouped into three general classes. The first class embraces deposition on the face of the producing sand, or within the well bore, of agents which impede the entry into the well bore, or the flow through the well bore, of the formational fluid. To the second class belong all types of sanding difficulties, while the third class includes intrusion of water.

All these three classes of difficulties have their effect on operation of pumping wells. The effect may range all the way from increased cost of lifting, due to wear on equipment and increased requirements of power, to conditions under which no further pumping of the well is possible. Somewhere between these two extremes there arises a need for reconditioning of the well. The remaining producing possibilities of the well are weighed against the cost of reconditioning and thus the decision as to the advisability of reconditioning is arrived at.

There has been developed a large number of methods and procedures to meet these difficulties. Briefly, the first group of these difficulties is solved quite often with considerable success by different methods of mechanical[1] and chemical cleaning. The sanding up, depending on the degree of difficulties involved and on the manner of completing of the well, may necessitate bailing of well or cleaning with tools, or resetting of liner or screen, or setting of inserted screen. The methods of combating intrusion of water range all the way from different procedures for exclusion of water from the well bore to directional redrilling of wells in case of piercement type domes.[2,3,4,5,6]

General discussion of all causes leading to need for reconditioning of wells and of methods of reconditioning used is beyond the scope of this series. Two of these causes, however, paraffin and corrosion, have to be included in consideration of oil-well pumping practices. While the paraffin and corrosion problems are encountered both in flowing and pumping wells, they are quite intimately associated with characteristics of the pumping phase of life of wells.

As far as pumping wells are concerned the paraffin problems can be divided into two groups. To the first group would belong problems resulting from deposition of paraffin in the tubing. To the second group would belong problems resulting from deposition of paraffin on the face of the producing sand or in the perforations of the liners. The pumping operations are affected also by deposition of paraffin in surface lines and indirectly by paraffin deposits in tanks. The problems of the first group include increased wear and tear on equipment, increased power demands, decreased ability of rods to fall freely, rod failures, difficulties in pulling rods, and others. The problems of the second group manifest themselves primarily in decline of production. Paraffin deposits in lead lines may result in decrease of production, increased power demand and wear of certain parts of pumping equipment.

Deposition of Paraffin

The economic effect of paraffin on pumping operations of wells is such that the problem always received considerable attention and was a subject of extensive research. The research was directed both toward analysis of factors causing formation and deposition of paraffin and toward development of methods for prevention of formation of paraffin and for means of its removal. Following is a discussion of basic principles of formation and deposition of paraffin, as outlined in selected technical papers covering this subject.[7,8,9,10,11]

Paraffins accumulated in production of paraffin and mixed-base crudes vary widely in composition and consistency. Their main constituents are waxes, the melting points of which were found, by laboratory procedures, to vary from 100° to 191° F. Other components are sand, silt, oil, gums and resins, and asphaltic material. The consistency of paraffin may vary from mushy liquid to hard granular solid and is a function of the age of the deposit, since the oil gradually drains from the wax particles, and the manner of deposition. For deposits of paraffin to occur, two processes must take place. First, the waxes must be precipitated from the wax-oil solution. Second, the wax crystals must adhere to some surface and agglomerate without being removed in suspension by normal flow of oil to the surface.

The precipitation of waxes is governed primarily by two factors, the temperature and the composition of oil. The solubility of waxes in crude oil decreases rapidly with decrease in temperature. Under reservoir conditions the waxes are in solution in crude oil. As the temperature of oil is lowered the waxes precipitate. Since the solubility of waxes decreases with increase in their melting point, the high-melting-point waxes are first to separate. The decrease of temperature of oil is a result of the radiation of heat and of cooling effect of the gas evolving from solution. As far as composition of oil is concerned, its effect is twofold. First, by evaporation of lighter constituents the total volume of oil is reduced, therefore the amount of waxes which can be carried in solution is also reduced. Second the waxes are more soluble in lighter fractions of crude oil than in the heavier ones. Loss of these lighter fractions reduces the ability of crude to hold the waxes in solution.

The waxes precipitate in form of very fine crystals. These crystals can be carried in suspension to the surface and to the tanks unless conditions occur which favor deposition of paraffin. Among these conditions intermittent wetting of the surface, resulting in film of oil draining away and wax crystals adhering to the surface, is an important factor. This condition is particularly favorable to deposition of paraffin if the surface is cooler than the oil. Other factors favoring deposition are dead fluid spaces; slow movement of oil; presence of suspended organic matter, which provides additional surface for wax crystals to adhere; and production of oil in form of mist, as in case of high oil-gas ratio wells, with resulting oil film on walls of tubing.

In case of pumping wells conditions favorable both to precipitation of waxes and to their deposition exist in abundance. In wells which are in the early stage of their pumping life, the so-called "agitating" stage, there is enough gas evolving from solution to provide the cooling effect in addition to loss of heat through radiation. At the same time, since part of the fluid is flown out of the tubing by the evolving gas, certain portion of tubing is periodically empty, which corresponds to intermittent wetting of the walls of

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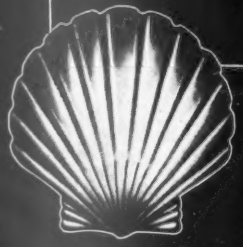

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tubing, a condition above referred to as favoring deposition of paraffin. In general the wells in agitating stage of pumping experience considerable paraffin difficulties. In pumping wells which are in the later stage of their life, the effect of the evolving gas is missing. Also, the increasing amount of water produced may minimize precipitation of waxes. On the other hand there is still the effect of loss of heat through radiation. Moreover, with low fluid levels there may be a tendency toward loss of lighter fractions as result of agitation. This would favor precipitation of waxes. Slow movement of fluid through tubing and intermittent wetting of walls of tubing favor the deposition.

As far as deposition of paraffin on the face of the producing sand and in perforations of the liners is concerned, this problem is of importance primarily in very old wells, particularly in those in which the fluid is pumped down below the face of the sand or below the perforated liner. In these cases the deposition is due to the fact that the flow of the fluid down the face of the sand, or the liner, is sufficiently slow and sufficiently small in volume to permit the wax crystals to adhere to the surfaces of the sand or the liner and to accumulate into the paraffin deposits. Evaporation of lighter constituents of oil is the principal cause of precipitation.

Precipitation of wax deposits in surface lines is a result of causes already discussed in conjunction with problem of wax precipitation in the tubing. The conditions are aggravated by high differentials between temperature of oil in line and outside temperature. The deposition is also a result of normal causes of paraffin deposition, already discussed. Length and size of lead line and number of fittings used also have their effect. Formation of paraffin deposits in tanks is a result of two actions. First, the wax crystals which precipitated from wax-oil solution but failed to form a deposit in tubing or surface lines are brought by the fluid, in suspension, to the tanks, where they settle to the bottom as the fluid becomes quiescent. Second, as oil in tank cools off, precipitation of new wax crystals takes place. They then also settle to the bottom of the tank.

As is the case with any operational problem the question of paraffin may be met in two ways. The first procedure would be to follow practices which would tend to prevent formation of paraffin. The second procedure is employment of methods for removal of paraffin.

Prevention of Paraffin Accumulation

Since the formation of paraffin deposits is a result first of precipitation of wax crystals and then their adhering and agglomerating on the available surfaces, the obvious procedures to prevent the paraffin deposition are those which tend to stop either or both these processes.

As far as paraffin in tubing of pumping wells is concerned maintenance of back pressure in case of agitating wells reduces the evolution of gas, removing the important cause of precipitation of waxes. Efficient gas anchors tend to have the same effect. Production at a rate which would eliminate intermittent wetting of walls of tubing and would decrease the loss of heat through radiation would tend to retard both the precipitation and the deposition of the crystals. Rod scrapers would serve mechanically the purpose of retarding the deposition. Heating of tubing by means of steam coils placed in the annulus between tubing or casing, or electric heaters placed below the point of accumulation of paraffin, would keep the temperature of oil above that causing precipitation. Chemicals could be used which if added continuously to the pumped fluid, would either prevent precipitation of waxes or would not permit the wax crystals to adhere to the walls of tubing. Neither of these methods, however, is an entirely satisfactory solution of the problem. Either they are not efficient enough, as far as attaining of

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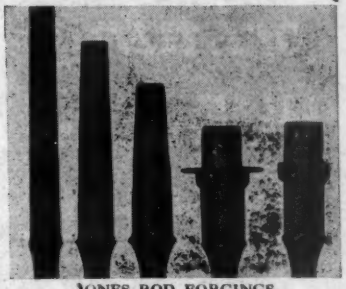

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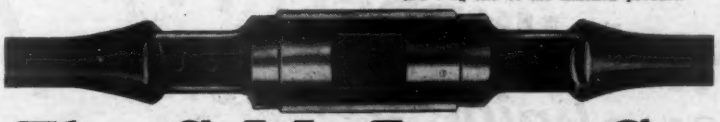

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the results is concerned, or they are too expensive. In many cases specific conditions do not permit their application. A questionnaire survey conducted on this subject by the American Petroleum Institute revealed an apparent consensus that with methods now available it is more economical to remove paraffin from tubing than attempt to prevent its formation.[10]

In surface lead lines prevention of paraffin deposition is quite often successfully accomplished by use of flow-line heaters, by use of back-pressure valves at the tanks, by change of diameter of flow lines, or by burying the lines. Decrease in diameter of flow line may increase sufficiently the velocity of oil to prevent deposition of paraffin. On the other hand too small diameter of flow line may result in need for more frequent cleanouts because of the small space available for accumulation of waxes.

Paraffin accumulation in tanks could be prevented by heating of oil in tanks. Economic balance, however, would have to be arrived at between cost of cleaning of tanks and gravity losses incidental to heating of oil. Gas-tight tanks sometimes reduce accumulation of paraffin by reducing loss of lighter constituents of oil.

Paraffin Removal Methods

In general the methods of removal of paraffin deposits can be divided into three classes—mechanical methods, thermal methods and use of solvents.

Mechanical methods, as the name implies, depend on mechanical action of different devices for removal of paraffin deposit from walls of tubing or pipe. Thermal methods use heat for melting of waxes, which are then removed from the well in liquid form. Different procedures are used for creation of heat. Steaming down the tubing or introducing of hot liquids is quite often employed. Chemicals are used, the chemical reaction of which results in creation of heat. An efficient and economical method of intermittent electrical heating has been developed. The third class of methods of paraffin removal utilizes solvents, such as kerosene, gasoline or benzol, or commercially produced chemicals to dissolve the paraffin waxes thus making possible their removal. Different techniques of application are employed. The important thing to remember in using thermal and solvent methods of paraffin removal is that the melting or softening of waxes is only one portion of the problem. Fully as important to the success of the cleanout is removal of suspended waxes.

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QUESTIONS ON TECHNOLOGY

by W. L. Nelson

West Texas Crude Oils

How much sulfur is in a West Texas crude oil? And do you have any other information on it that might be good for us?—B. L. B.

There are many kinds of West Texas crude oil, nor is any very great consistency exhibited between the many different crude oils. In a most general way they are relatively high in sulfur, the gasolines produced from them are high in octane number, the gravities of the crudes are usually lower than the average for the country, and the straightrun gasoline content is somewhat low.

The sulfur content of West Texas crude oils is indicated in Fig. 1 and Table 1. This figure only serves to indicate that there is no direct relationship between the gravity of these crude oils and the percentage of sulfur that they contain—that laboratory data on each crude oil must be obtained. It must be pointed out, however, that degree of corrosiveness is not a direct function of sulfur content. Thus, the crude oils of highest sulfur content are not necessarily the most corrosive. During topping distillation of West Texas crudes, there is a tendency for the sulfur to be concentrated into the high-boiling products, so that the straightrun gasolines contain far less sulfur than the crude oils.

Similar information but relating gravity and gasoline content is given in Fig. 2. Here again there is not much consistency except that data on intermediate base crude oils appear to cluster along one line, whereas the naphthene and naphthene-intermediate base crudes occupy a region of much higher gasoline content. Naphthene base crude

TABLE 2

Approximate Octane Numbers of West Texas Naphthas (A.S.T.M. Method)

End point (°F.)	Westbrook crude*	Slaughter crude	Mitchell and Howard counties*	Private files
253	...	67	..	..
300	...	..	72	..
350	62.5	..	64	67
375	59.0	..	60	..
385	...	62	..	..
400	...	..	58	62
415	54.5	..	..	..
435	53.0	..	57	..
450	52.0	..	53	..

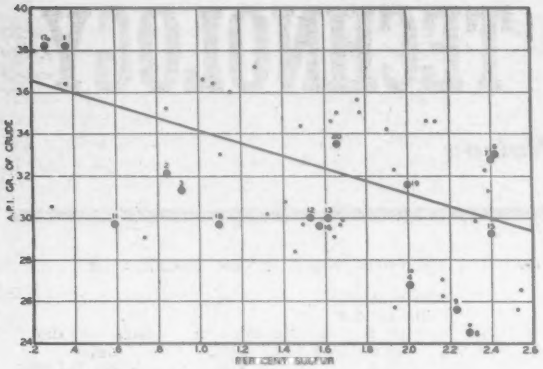
*Item 18, Table 1.

TABLE 1—PROPERTIES OF SOME WEST TEXAS CRUDE OILS

No. or symbol	Name of crude—	A.P.I.	Per cent gasoline around 400° F. e.p.	Oct. No. (A.S.T.M.)	Per cent sulfur	Reference and notes
1	Big Lake	38.2	32.8	...	0.36	B. of Mines, R.I. 2849
2	Chalk	32.1	25.0	...	0.84	B. of Mines, R.I. 2849
3	Chalk	31.3	23.7	...	0.91	B. of Mines, R.I. 2849
4	Chalk	26.8	21.2	...	2.02	B. of Mines, R.I. 2849
5	Church & Fields	31.1	26.8	...	2.69	B. of Mines, R.I. 2849
6	McElroy	33.0	27.0	...	2.42	B. of Mines, R.I. 2849
7	McElroy	32.8	26.6	...	2.40	B. of Mines, R.I. 2849
8	McCamey	24.5	14.5	...	2.29	B. of Mines, R.I. 2849
9	McCamey	25.6	15.8	...	2.23	B. of Mines, R.I. 2849
10	Westbrook	25.8	32.0	...	...	O.&G.J., Apr. 2, 1931 (U.O.P.)
11	World	29.7	18.8	..	0.59	B. of Mines, R.I. 2849
12	Hendricks	30.0	22.7	...	1.53	B. of Mines, R.I. 2849
13	Yates	30.0	22.2	...	1.61	B. of Mines, R.I. 2849
14	Yates	30.4	24.0	...	...	U.O.P.
15	Yates	29.3	22.2	...	2.40	University of Texas
16	Yates	29.6	24.0	...	1.55	U.O.P.
17	Texon (nearly paraffin base)	38.2	32.8	...	0.26	U.O.P.
18	Westbrook	29.2	29.0	58.5	1.09	Scoggin & Burruss, O.&G.J., Oct. 21, 1943. p. 61
19	Slaughter-Duggan	31.6	34.1	54.7	2.00	Wenzke, H. H., O.&G.J., Oct. 14, 1943. p. 43
20	Wasson	33.5	36.8	...	1.66	.....
21	Slaughter	31.7	33.2	56.1	1.93	.....
22	Winkler County	28.0	19.8	62.4	...	University of Tulsa
23	Winkler County	36.2	32.7	57.4	...	University of Tulsa
24	Taylor-Link, Pecos Co.	30.2	21.0	59.0	...	U. of Tulsa, 424 e.p.
25	Upton County	27.2	16.2	61.0	...	U. of Tulsa, 434 e.p.
26	Pecos County	30.5	24.9	63.9	...	University of Tulsa
27	Apco	38.6	27.0	...	0.27	B. of Mines, R.I. 3744
28	Big Lake	36.4	29.2	...	0.36	B. of Mines, R.I. 3744
29	Big Lake	41.5	32.9	...	0.14	B. of Mines, R.I. 3744
30	Cowden, Northfield	35.0	33.6	...	1.66	B. of Mines, R.I. 3744
31	Crane, Cowden	32.3	28.2	...	2.37	B. of Mines, R.I. 3744
32	Dune	34.4	29.9	...	1.49	B. of Mines, R.I. 3744
33	Embar-Ellenburger	44.9	40.4	...	0.18	B. of Mines, R.I. 3744
34	Foster	36.4	33.3	...	1.07	B. of Mines, R.I. 3744
35	Fuhrman	22.5	14.4	...	4.17	B. of Mines, R.I. 3744
36	Fullerton	43.2	36.0	...	0.48	B. of Mines, R.I. 3744
37	Goldsmith	34.2	27.0	...	1.90	B. of Mines, R.I. 3744
38	Harper	36.0	34.1	...	1.15	B. of Mines, R.I. 3744
39	Hendrick	29.7	22.4	...	1.49	B. of Mines, R.I. 3744
40	Howard-Glasscock	29.1	20.7	...	1.64	B. of Mines, R.I. 3744
41	Iatan, East Howard	30.8	31.3	...	1.41	B. of Mines, R.I. 3744
42	Jordon	34.6	31.1	...	2.13	B. of Mines, R.I. 3744
43	Kermit	28.4	18.1	...	1.45	B. of Mines, R.I. 3744
44	Keystone	35.2	30.2	...	0.84	B. of Mines, R.I. 3744
45	Leck	29.1	21.6	...	1.64	B. of Mines, R.I. 3744
46	McElroy	31.3	27.3	...	2.39	B. of Mines, R.I. 3744
47	Payton	33.0	25.6	..	1.10	B. of Mines, R.I. 3744
48	Pecos Valley	34.6	32.4	...	1.09	B. of Mines, R.I. 3744
49	Pecos Valley	29.7	24.8	..	1.67	B. of Mines, R.I. 3744
50	Seminole	35.6	34.4	...	1.76	B. of Mines, R.I. 3744
51	Scarborough	36.6	34.1	...	1.02	B. of Mines, R.I. 3744
52	Shipley, Silurian	30.6	7.7	...	0.29	B. of Mines, R.I. 3744
53	Slaughter	32.3	32.0	...	1.93	B. of Mines, R.I. 3744
54	Snyder	29.9	29.0	...	1.68	B. of Mines, R.I. 3744
55	Taylor-Link	30.2	20.9	...	1.32	B. of Mines, R.I. 3744
56	Tobarg	25.7	17.9	...	1.93	B. of Mines, R.I. 3744
57	Waddell	44.7	34.8	..	0.22	B. of Mines, R.I. 3744
58	Ward	35.0	33.6	...	1.77	B. of Mines, R.I. 3744
59	Ward, South	37.2	32.4	...	1.27	B. of Mines, R.I. 3744
60	Wasson	34.6	35.0	...	1.63	B. of Mines, R.I. 3744
61	Wheat	38.0	29.5	...	0.21	B. of Mines, R.I. 3744
62	World	29.1	14.3	...	0.73	B. of Mines, R.I. 3744

.. Unnumbered points taken from the Bureau of Mines (A. Foster, The Oil and Gas Journal, Sept. 30, 1943).

... Unnumbered points taken from "Analyses of Texas Crude Oils" of the Railroad Commission of Texas, Oil and Gas Division.



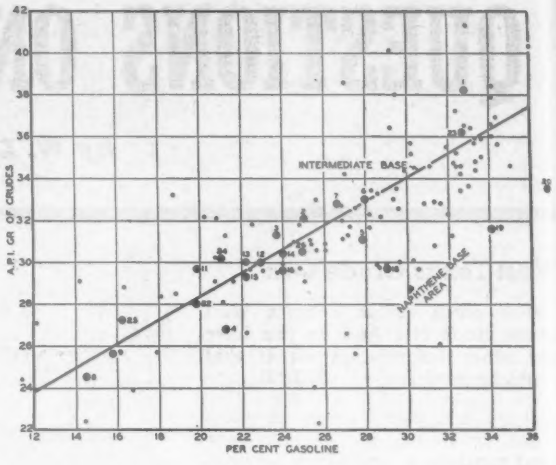


Fig. 1 (Above): West Texas crude oils—A.P.I. versus per cent sulfur. Fig. 2 (Right): West Texas crude oils—A.P.I. versus gasoline content—400-410° E.P. (Numbers of crude oils shown in Table 1)

oil of very low A.P.I. gravity does not behave as indicated in Fig. 2.

The outstanding octane number of West Texas gasolines is of real economic significance. Several large operators have recognized this valuable advantage for many years and have processed these crudes even though some difficulty with corrosion was encountered. Motor-method octane numbers range from about 50 to 64 for gasolines having an end point of 400° F. Some octane-number data are indicated in Table 1. In addition Table 2 shows the octane numbers of gasolines of lower end point. All of the data are for raw gasolines. Obviously desulfurized gasolines have higher octane numbers and better susceptibilities to tetraethyl lead.

The excellent publication entitled, "Analyses of Texas Crude Oils," by the Railroad Commission of Texas (1900) lists about 62 crude oils from the West Texas area (District 8). Although octane numbers range from as low as 22 and up to 65, a total of 47 of the 62 crude oils have octane numbers between 50 and 60.

Edwin W. Pauley, Los Angeles, oil producer and marketer, president of Petrol Corp., and national treasurer of the Democratic party, passed around the cigars recently with the announcement that he was the father of a baby boy at St. Vincent's Hospital, Los Angeles.

C. M. Keller, district landman for Tide Water Associated Oil Co. in Evansville, Ind., has been transferred to Oklahoma City to take the place of **Floyd Newlin,** recently assigned to Wichita, Kans.

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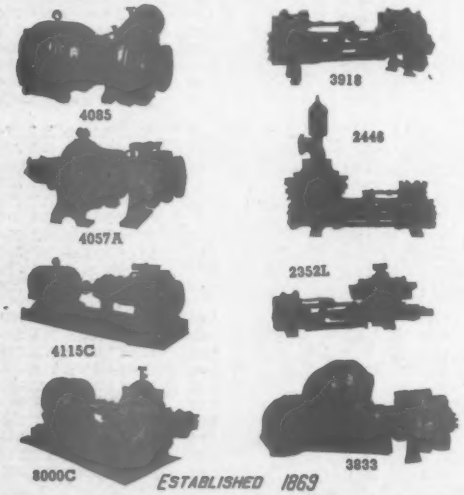

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LARGE CASING MAY REQUIRE ANCHORAGE WHEN CEMENTING

ARCHIMEDES' Principle is a well-known law of physics which states that when a solid body is immersed in a fluid there is a buoyant force, equal to the weight of fluid displaced, acting upward on the solid body.

In the cementing of oil-well casing of large diameter, it is well not to lose sight of the principle of Archimedes. Failure to recognize this fundamental physical law may result in rather serious difficulties in certain cases. In the discussion to follow it will be shown how that such difficulties may arise.

Surface pipe installed in an oil well may be rather large in diameter as compared to the longer strings of pipe. It is not uncommon in certain localities to install 18⅝- or 20-in. surface casing. There are available sizes of 21½ in. and 24½ in. which are sometimes used. When cementing by the two-plug method, the process is completed with a cement slurry, weighing approximately 120 to 125 lb. per cu. ft., on the outside of the casing and drilling mud or water weighing much less, possibly as low as 70 or 75 lb. per cu. ft., on the inside of the casing. At least it is possible, when installing large casing with a wide difference between the density of the cement slurry and the density of the mud used to pump down the cementing plug, that the buoyant force of the unset cement slurry on the outside of the pipe may sufficiently exceed the weight of the pipe and its contents actually to cause the casing to rise out of the hole as the top cementing plug is pumped down.

The rising of the casing from the hole under such circumstances is opposed by the frictional contact of the pipe with the walls of the hole as well as by the weight of the pipe and its contents. Nevertheless, there are certain sets of conditions in which a combination of all of these forces may be insufficient to prevent the casing from rising by the action of the buoyant force of the cement slurry. It is necessary then, under such circumstances, to provide some sort of tiedown, or anchor, of sufficient strength to oppose the excess of the buoyant force over the weight of the casing plus the weight of its contents plus the frictional resistance to upward movement. Naturally, after the cement slurry has set it is no longer a fluid and there is no further need for the tiedown.

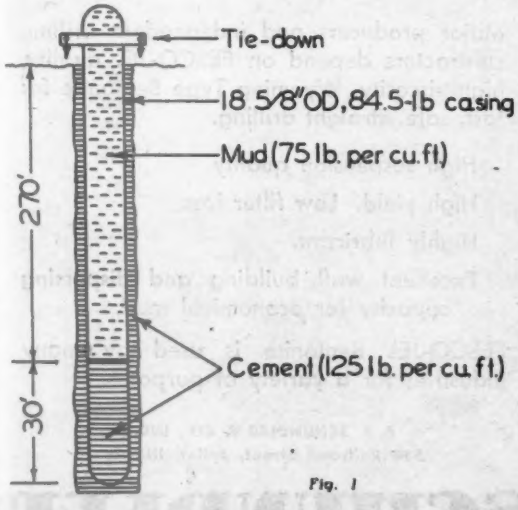


Fig. 1

Since it is difficult if not impossible to evaluate the frictional resistance to movement of the pipe in a hole, it is best to use a tiedown of sufficient strength to hold a force equal to the buoyant force of the casing and its contents.

Example

Problem: A string of 18⅝-in. o.d. (17.755 in. i.d.) plain-end casing is to be cemented at a depth of 300 ft. using the two-plug process. The top plug is to be pumped to 270 ft. Sufficient cement is to be used to reach the surface behind the casing. The cement slurry weighs 125 lb. per cu. ft. and the mud used to pump the plug down weighs 75 lb. per cu. ft. Calculate the upward force that will be exerted upon an anchor in holding the pipe in the hole at the completion of the cementing operation. (Neglect friction of pipe against walls of the hole.)

Solution: (See Fig. 1.)

The volume of cement slurry displaced by the pipe would be:

$$v = \frac{\pi(18.625)^2 \times 300}{4 \times 144} = 567 \text{ cu. ft.}$$

The weight of cement slurry displaced would be:

$$W = 567 \times 125 = 70{,}875 \text{ lb.}$$

The volume required to fill 1 ft. of the casing is

$$\frac{\pi (17.755)^2}{4 \times 144} = 1.719 \text{ cu. ft.}$$

The weight of mud inside the casing is $1.719 \times 270 \times 75 = 34{,}810$ lb.

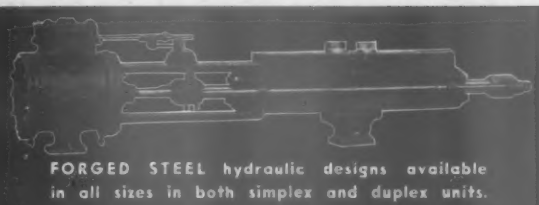
The weight of cement slurry inside the casing is

$$1.719 \times 30 \times 125 = 6{,}445 \text{ lb.}$$

Casing with the given dimensions weighs 84.5 lb. per ft. in air. Then, the weight in air of the 300-ft. string is 84.5×300, or 25,350 lb.

The upward force exerted on the anchor, then, would be equal to the weight of cement displaced less the sum of the weight of the pipe and its contents, or 70,875 — (34,810 + 6,445 + 25,350), or 4,270 lb.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma



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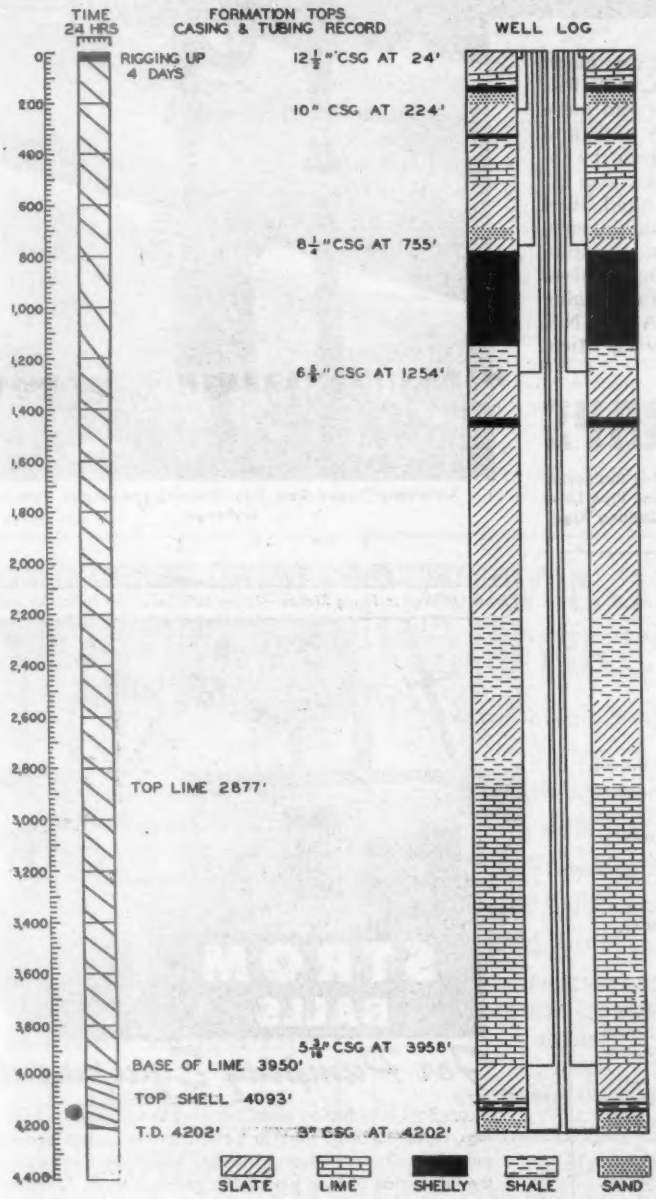

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CONTRACTOR

Company Tools

DRILLING DATA

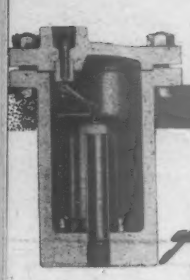
Type of rig	Cable tools
Rigging up, days	4
Drilling time, days	42½
Shut down, days	14
Running casing, hours	16

COMPLETION

Explosive	Glycerin
Quantity explosive	420 lb.

PRODUCTION TEST

Time flowed	24 hr.
Oil	105 bbl.
Water	None
Gas	Not gaged
Type oil	Pennsylvania Grade



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REFINING

Globe's Blackwell Refinery To Be Salvaged and Sold

BLACKWELL, Okla.—Globe Oil & Refining Co., Wichita, Kans., has disposed of its refinery and other properties here including 50 acres of land to Globe Salvage, a partnership composed of W. D. Scallon, of Blackwell, and Lee Walker and Ray Humphries, of Tonkawa, Okla. The equipment will be salvaged and offered for sale. Globe retains its pipe line and gathering system in the Blackwell and Hubbard districts, with F. A. Smalley as pipe-line superintendent. The refinery had a rated capacity of 8,000 bbl. daily when it was shut down several years ago.

Scallon joined the O'Shaughnessy-Globe interests about 20 years ago, and was traffic and office manager until headquarters were moved to Wichita. Walker was with Globe for 15 years as foreman.

Group to Aid in Equitable Distribution of Crude

CHICAGO.—Appointment of a crude-oil supply subcommittee to aid in the equitable distribution of crude available for refiners in District 2 of Petroleum Administration for War has been announced by Ralph K. Davies, deputy petroleum administrator. The subcommittee, directly responsible to the general committee of District 2, is composed of Reid Brazell, Leonard Refineries, Inc., chairman; L. T. Weger, The Ohio Oil Co., vice chairman; R. G. Arner, Sinclair Refining Co.; H. T. Ashton, Socony-Vacuum Oil Co.; M. E. Foster, Phillips Petroleum Co.; A. P. Ruether, Shell Oil Co., Inc.; G. W. Sanders, Pure Oil Co.; G. G. Woodruff, Globe Oil & Refining Co.

For the purpose of submitting recommendations to the director in charge, District 2, with respect to the quantity of crude oil which should be allocated to individual refiners from other refiners, the new subcommittee is to obtain and analyze all pertinent facts and figures regarding the availability of crude oil in District 2, refiners having crude oil in excess of authorized runs, and refiners lacking crude oil. In making its recommendations the crude-oil supply subcommittee's job is to see that all refiners who lack sufficient crude receive approximately the same percentage of "normal crude runs."

Unfilled Orders for Heat Exchangers $132,066,000

WASHINGTON.—Unfilled orders for heat exchangers, among important equipment items in the modern oil refinery, totaled $132,066,000 at the end of March, according to estimates of War Production Board. Shipments in that month represented $14,710,000, a jump of $1,651,000 from the $13,059,000 recorded in February. There was a sharp upturn in new orders received by manufacturers in December 1943, $36,409,000, compared with $15,965,000 in November. There was another spurt in February, when new orders aggregated $21,584,000, compared with $8,822,000 in January.

Lowest Gasoline Stocks Reported on Gulf Coast

HOUSTON.—A new low in gasoline stocks for the 5 years during which Gulf Coast Refiners Association has been in operation is reported by its 11 active companies for the first half of June. Stocks of all grades decreased 12,085 bbl. and were reported at 1,191,518 bbl. A year ago total gasoline stocks held by the GCRA group were 2,298,084 bbl., 1,106,566 more than is now

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held in inventory. Automotive gasoline stocks, considered alone, were 416,436 bbl., indicating a drop since June 1 of 12,872 bbl. and this total represents approximately 40 per cent of the automotive gasoline held at this time last year. About one-fifth of the current stocks of automotive gasoline is a special military grade and not available for civilian use.

Operating at near capacity rating, the 11 refiners reported total daily crude-oil throughput of 119,539 bbl., which is 40,394 bbl. higher than was reported the first half of June last year. Charging rate during the period was 89.5 per cent of present rated capacity of 140,000 bbl. daily, compared with 54 per cent a year ago, when this refining district was operating under restriction.

Kerosene stocks at 192,259 bbl. June 15 indicate an 80,782-bbl. increase. Diesel gas-oil stocks were 38,467 bbl., a 19,419-bbl. decline. Stocks of several other grades of gas oil increased 239,234 bbl. from 690,150 on June 1 to 929,384 bbl. on June 15. Stocks of heavier fuels continue low with No. 5 fuel reported at 243,050 bbl. and Bunker C fuel oil at 348,826 bbl. on June 15. Cut-back asphalt was reported at 44,205 bbl. Total stocks of all products in the 11 refineries were reported at 3,159,-137 bbl. on June 15, an increase of 325,465 bbl., compared with total stocks a year ago of 3,953,516 bbl. when crude runs to stills were at a much lower rate.

Nazi Refineries Blasted and Oil Reserve Dwindling

ROME. — Headquarters of the Mediterranean Allied air force said last week that at least 20 of 22 oil refineries attacked by Italy-based bombers had been rendered useless by the middle of June and that Nazi oil reserves were "being used up at a faster rate than ever before." The statement said that nearly 4,800 planes had dropped about 11,000 tons of bombs on Nazi oil facilities, including rail yards serving refineries. Production at Ploesti, source of 35 per cent of the German oil supplies, was said to have been cut to low levels.

"More than half the German synthetic oil production has been knocked out by attacks of the Eighth Air Force based in the United Kingdom," the announcement said. "So much damage has been done to oil plants, ranging almost from the Baltic to the Black Sea, that the enemy's stored reserves represent his main cushion against having his military machine brought to a grinding halt."

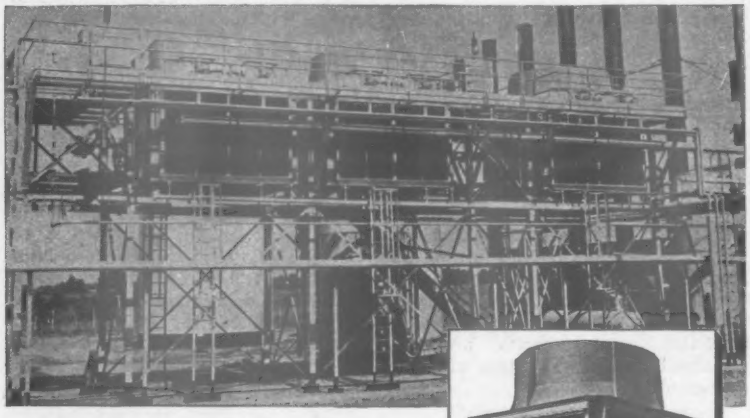
Shell Lubricant Engineers Study Rust Preventives

NEW YORK.—Protection of metal against rust and corrosion had a leading place in discussions at the 3-day meeting June 26-28, held in the De Soto Hotel here by industrial engineers and research workers of Shell Oil Co., Inc., from the United States and Canada.

Manufacturing researchers who have developed new products explained the properties of these products to the industrial engineers, who must arrange for their practical application, the industrial engineers, in constant touch with the users of the products, discussed with the research men what is needed in additional new products on which Shell is already at work.

Rust-preventive oil and fingerprint removers which Shell will market as the Ensis line, were announced. Much of the war equipment shipped abroad is carried as deck cargo where it is exposed to the severest weather, in addition to the corrosive effects of salt air and salt spray. Even the internal sections of gasoline and diesel engines must be safeguarded by special rust preventives from the time they leave the factory until they reach a combat zone.

The new Shell protective coatings



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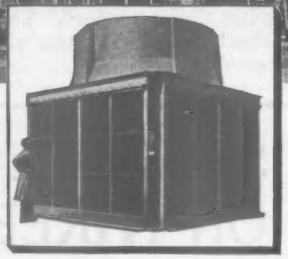

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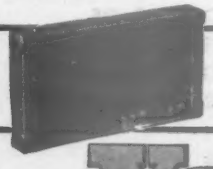

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High-Octane Expansion In California Announced

LOS ANGELES.—Plant expansions representing expenditure of $6,249,553, to help meet the demand for aviation gasoline, were approved last week by the Los Angeles area production urgency committee. The projects, recommended by Petroleum Administration for War and announced by Louis M. Dreves, War Production Board chief, include new work at the General Petroleum refinery at Torrance to cost $4,291,910, and plant expansion at Union Oil Co. of California's Wilmington plant at a cost of $1,569,700. Technical improvements at Wilshire Oil Co., The Texas Co., Shell Oil Co., Inc., and Standard Oil Co. of California refineries make up the rest of the approved work.

Labor Board Orders New Election at Newark Plant

WASHINGTON.—Setting aside an employes election and directing a new election to be held, the National Labor Relations Board recently charged that Pure Oil Co., of Newark, Ohio, had influenced its employes in choosing bargaining representation between an independent union and the Oil Workers International, CIO.

A new election will be ordered, the NWLB said.

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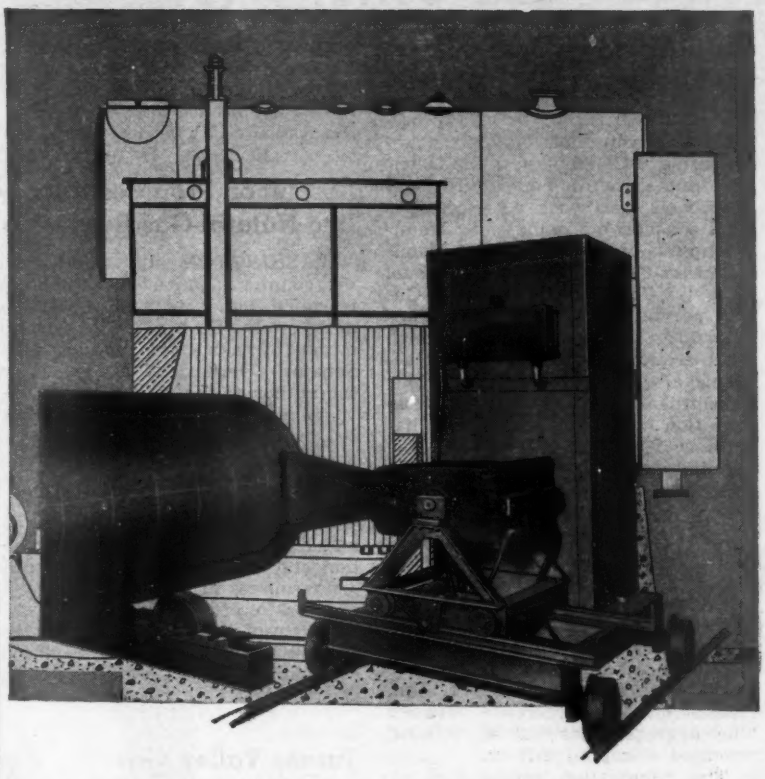

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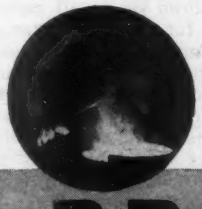

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Natural Gas

SEC Approves Plan for Merging Columbia Units

PHILADELPHIA.—A plan providing for consolidation of four subsidiaries of Columbia Gas & Electric Co. and dissolution of a fifth was approved last week by Securities and Exchange Commission. Manufacturers Light & Heat Co., Manufacturers Gas Co., Pennsylvania Fuel Supply Co., and Greensboro Gas Co. will be merged into a new Manufacturers Light & Heat Co., which will acquire all the assets and assume all the liabilities of the four constituent concerns. The new corporation will acquire assets and liabilities of Fayette County Gas Co. preliminary to dissolution of that company.

One provision of the plan involves issuance by the new company of 581,645 shares of $50 par value common stock to the parent corporation and 15 shares to the minority interests in Manufacturers, or an aggregate of $29,083,000 in exchange for the outstanding stock of the four constituent companies, aggregating $35,058,400. The difference between the aggregate par values will be credited to capital surplus.

The commission conditioned its approval on the provision that Columbia must supply any deficiency, if the proposed capital surplus is inadequate.

Sales Doubled, but Earnings Down and Taxes Up 133%

WICHITA FALLS, Tex.—Sales of Lone Star Gas Co. have doubled since Pearl Harbor, but earnings have dropped 34 per cent, and taxes have skyrocketed 133 per cent, D. A. Hulcy, president, told a meeting of employes here last week commemorating the thirty-fifth anniversary of the company. The tax bill now amounts to $2.40 for each monthly gas bill sent out. With 60,000 new customers gained since the war started, the company has been forced to operate with 663 fewer employes. Notwithstanding this reduction in manpower, the payroll has risen $650,000 a year.

Employes in war service will be reemployed upon their discharge, Hulcy said, adding: "This is not only a legal requirement, but the management considers it a moral obligation as well." A pension plan for all employes is being developed. Lone Star has 900 men in war service. At least 10 have lost their lives.

Resolution Proposes Inquiry Into Natural-Gas Resources

WASHINGTON.—Investigation of the country's natural-gas resources is called for in a resolution submitted to the Senate commerce committee by a special subcommittee. Senator Overton, of Louisiana, is the author of the resolution. It recommends an appropriation of $100,000 to defray the costs of the proposed inquiry, which would be conducted by Federal Power Commission.

Overton said the proposed study would determine the extent, location and availability of all natural-gas resources in the country and inquire into present economic usage or waste of the gas. The commerce committee will act on the resolution immediately after summer recess, Overton said.

Turner Valley Gas Ordered Conserved

CALGARY, Alta.—First step in a program of eliminating Turner Valley gas wastage is the issuing of orders by the newly constituted Natural Gas Utilities Board of Alberta covering the handling of all natural gas produced in Turner Valley.

Under the initial order, British-American Oil Co., operating an absorption plant in South Turner Valley, is required to install necessary equipment for gathering gas from all producing wells in its area and to return to the formation the gas not required for the market. Similar orders are being issued to Gas and Oil Products, Ltd., and to Madison Natural Gas Co., which has taken over the natural gas and absorption operations of Royalite Oil Co. Each company will handle all gas production, including that of low-pressure wells, in its particular area, producing companies sharing pro rata in the proceeds of marketed gas and being paid a nominal rate for gas stored in the formation.

Construction of gathering lines, compressor station and repressuring equipment for British-American Oil Co., to start at once, is estimated to cost around $500,000. The Madison company already has considerable equipment.

Natural-Gas Allowable for July Set by Commission

AUSTIN. — Allowable daily production for sour natural gas in the Panhandle field was fixed at 673,362,000 cu. ft. for July by the Texas Railroad Commission. The sweet-gas allowable for the Dabney sand, Agua Dulce field, was set at 25,000,000 cu. ft.

Northern Natural Plans to Supply St. Paul Area

WASHINGTON. — Federal Power Commission will hold a hearing in St. Paul July 26 on applications of Northern Natural Gas Co., Omaha, for authority (1) to sell approximately 120,000,000 cu. ft. of natural gas annually to Northern States Power Co. for mixing with manufactured gas for resale in St. Paul and nearby communities, and (2) to sell natural gas to Northern States at designated points for resale either as straight natural gas or as mixed gas and to sell natural gas to the applicant's affiliate, Peoples Natural Gas Co., for resale in St. Paul to Ford Motor Co. and Waldorf Paper Products Co.

Recycling

Construction of Haynesville Plant to Be Started Soon

SHREVEPORT. — Construction of the $1,600,000 cycling plant in the Haynesville oil field will begin about July 15, according to the operators' committee which is sponsoring the project. The committee represents 16 oil companies. Midstates Oil Corp. and The Ohio Oil Co. each has 30 per cent interest in the project, which is designed to process petroleum products from gas now wasted and then pump the gas back into producing strata to maintain field pressure. The cycling plant will be built in the middle of the field, which lies in Claiborne Parish, Louisiana, and Columbia County, Arkansas.

Jones & Laughlin Supply Co., engineering and construction division, Tulsa, which has the contract for the plant, and Sharman & Allen, Houston, who will lay 105 miles of pipe line in the field, have announced they will have work under way by mid-July.

All three are Pittsburgh

DRILL PIPE

Make	Depth	Size	Weight
Pittsburgh	4,953'	5-9/16"	22.20 lb.
"	10,000'	4-½"	16.60 lb.
"	15,279'	3-½"	13.30 lb.

INTERMEDIATE CASING STRINGS

Make	Grade	Depth	Size	Weight
Pittsburgh A.P.I.	J-55	1,940'	13⅜"	54.5 lb.
" "	N-80	8,900'	8⅝"	36 lb.

OIL CASING STRING

Make	Depth (Feet)	Wt./Ft. Lbs.	Footage Run	Total Wt. of Section	Type of Joint
Pittsburgh A.P.I.	0-4,024	23	4024	92,552	8-thd. Acme
" "	4,024-5,786	20	1762	35,240	Long Collar
" "	5,786-10,079	17	4293	72,981	Long Collar
" "	10,079-12,916	20	2837	56,740	Long Collar
" "	12,916-15,278	23	2362	54,326	Long Collar

TUBING

Make	Grade	Size	Weight
Pittsburgh	N-80	2-⅜" O. D. (nom. size 2")	4.70 lb.

E, CASING and TUBING

ever proved so good

Pittsburgh used all the way in World's Deepest Well

They drilled *deep* at Phillips-Price No. 1 well, Peco County, Texas . . . deeper than any well had eve penetrated the earth. And they chose *Pittsburgh* Dril Pipe, Casing and Tubing for the job.

After spudding and setting surface string, th entire well was drilled with *Pittsburgh* Drill Pipe, an finally stopped at a world's record depth of 15,27 ft. *Pittsburgh* Casing was landed at that depth an cemented. Pittsburgh Tubing was selected for th testing operations . . . and oil field history had bee made again!

Thus has been *proved,* by actual *field performanc* all the plus-factors of superiority formerly attribute to Pittsburgh Oil Country Tubulars by engineerin calculations alone. *Now* has been *demonstrated* be yond shadow of doubt that *Pittsburgh* excels in poin of steel integrity, design and fabrication.

No counter claims can detract one iota from th indisputable *proof* that only Pittsburgh Drill Pipe Casing and Tubing ever met and mastered condition encountered 15,279 feet down!

Plan to use Pittsburgh "all the way" in *your* nex well.

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PIPE LINE SERVICE

In an operation as important as pipe protection, it is costly and troublesome to divide responsibility by ordering coatings from one source, wrappings from another and application from still a third.

To save you time, trouble, and money and insure satisfaction on every job, Pipe Line Service Corporation provides a complete service that takes all the headaches out of pipe protection. Our specialists take care of *all* the details, all the work. There is no division of responsibility, no chance of slip-ups.

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  - —at yard or railhead
  - —over the ditch
- Pipe Cleaning Service
- Pipe Storage
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PIPE LINES

Cimarron Valley Line to Serve West Edmond Field

Petroleum Administration for War has concluded that crude-oil movements from the West Edmond, Oklahoma, field should be handled through the system of Cimarron Valley Pipe Line Co. which is regarded as having ample capacity for serving the field. As long as capacity is sufficient no new line will be approved. Present capacity of the Cimarron system for serving the West Edmond production of 14,000-15,000 bbl. daily is reported to be 40,000 bbl. daily which can be handled through 4 miles of 4-in. and 6-in. to the company's Oklahoma City-Enid, Okla., 8-in. trunk line.

The PAW decision specifies that Cimarron Valley is to accept and transport oil at the direction of owners and to discontinue its present policy of "purchase and resale." Tariffs are to be established by agreement with shippers in accordance with regulations of the Oklahoma Corporation Commission.

Under the arrangement specified for the future operation of the Cimarron Valley Pipe Line Co., it will be necessary for Champlin Refining Co. to obtain what crude it requires from the field by direct purchase or exchange. The Cimarron Valley company is a Champlin subsidiary.

Since the new program for the West Edmond crude-oil transportation program is being carried on at the request of PAW, it is regarded as being undertaken without prejudice to Cimarron Valley Pipe Line Co.'s status as a private carrier.

Bayou Breaks Its Throughput Record

The Bayou Pipe Line System set a new delivery record during June by pumping a daily average of 64,156 bbl. products from Houston, Texas City, Beaumont and Port Arthur, Tex., refineries into the Plantation pipe-line terminal at Baton Rouge, La. Products moved during the 30-day period included 1,247,634 bbl. of regular gasoline; 560,000 bbl. premium gasoline and 116,398 bbl. kerosene.

The line is built of 10-in. pipe from Port Neches to Baton Rouge.

Since the line started operation on February 15, 1943, it has delivered 28,371,977 bbl. of products and despite the fact that it was constructed with second-hand line pipe it has experienced a shrinkage and evaporation loss of only 67,519 bbl. or an average of 0.238 per cent. For the first 6 months of 1944 this loss averaged 0.151 per cent. Only one main line break has occurred during the entire 17 months of operation.

The Bayou Pipe Line System is a privately financed, joint ownership venture of the Humble, Texas, Shell, Pan American, Pure and Crown Central companies, costing 8¼ million dollars. Each of the six owners separately handles its own business with its shippers through the line. The system was designed and constructed and is operated by Shell Pipe Line Co.

Two More Sections of Tennessee Line Contracted

For the construction of Tennessee Gas & Transmission Co.'s line from Corpus Christi, Tex., to West Virginia, two sections have been recently contracted.

J. R. Horrigan Construction Co. will lay a section northeast from Centerville, Tenn., for a distance of 30 to 50 miles. From Centerville, Jones & Brooks will lay 30 miles in a southwesterly direction.

Phillips Lets Contracts For West Texas Lines

Contracts for 200 miles of 2-in. to 24-in. pipe for a crude-oil gathering system in the vicinity of the Fullerton pool in the West Texas producing area were let early this week. The work is to be commenced immediately for Phillips Petroleum Co.

Permit to Purchase Sought By New York State Natural

The Federal Power Commission last week announced its order setting hearing for July 14 at Washington, on an application filed by the New York State Natural Gas Corp. Applicant seeks authority to purchase from the Peoples Natural

Gas Co. for $815,256.77 an 89-mile 12-in. pipe line located in Pennsylvania, and a private telephone line paralleling the pipe line from a point in Clarion County to an interconnection with the applicant's 10-in. line in Potter County, Pennsylvania.

Swensrud Urges Use of Both WEP Lines for Gas

Use of both the 24-in. and 20-in. War Emergency pipe lines after the war for moving natural gas from Texas to the New York-New Jersey-Philadelphia area is proposed by Sidney A. Swensrud, vice president, Standard Oil Co. (Ohio), in the summer number of the Harvard Business Review. Swensrud points out that "the disposition and future use of these lines constitutes one of the most important problems of postwar readjustment in the oil industry.

"The use of both lines for gas service rather than only one would be an advantage from the standpoint of protection against emergency interruptions.

"In the event of another emergency, by arrangement of the oil-pumping and gas-compressing facilities so as to increase the number of stations on each line, one of the lines could be used for oil deliveries while the other line still delivered large quantities of gas."

C. S. FOREMAN COMPANY

General Contractors

PIPE LINES

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Built by Buckeye
TRENCHERS · SHOVELS · CRANES
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Cities Service Gets FPC Permit for New Facilities

The Federal Power Commission last week issued a certificate of public convenience and necessity to the Cities Service Gas Co. to construct and operate (1) a cooling tower and miscellaneous equipment at the company's Blackwell compressor station in Kay County, Oklahoma; (2) 35 miles of 16-in. loop line from the Blackwell station to Burbank, Osage County, Oklahoma. The facilities will be used for the transportation of increased volumes of natural gas from the "west side" to the "east side" of the company's pipe-line system where demands are greatest. This assures continued service to the applicant's "east side" customers, including war industries. The order provides that the company shall complete the construction of the facilities on or before December 31, 1944.

Cities Service Gas Co.'s system serves an area in northern Oklahoma, eastern Kansas, southern Nebraska and western Missouri, including the metropolitan areas of Kansas City, St. Joseph, Joplin and Springfield, Mo., and Kansas City, Lawrence, Topeka, Leavenworth, Wichita and Hutchinson, Kans.

Oklahoma Natural Builds Center Point Outlet

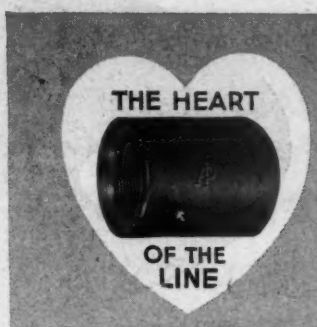
Oklahoma Natural Gas Co. is laying a 6-in. 7-mile pipe line from the Center Point field in Pottawatomie County to connect with its system near Shawnee, Okla. This is the first outlet for the area, which also produces oil.

The company has completed a 34-mile extension of 12-in. line from 6 miles north of Holdenville to the Citra and Lula gas fields in Coal County. Loops extend to several smaller areas along the route.

Oklahoma Natural has been in the market for all types of compressors with a view of installing them in the small, low-pressure gas areas of the state; in several instances this practice has stopped waste of gas.

Union Producing Lays Line To Panola Outpost Test

MARSHALL, Tex. — Union Producing Co. has started laying a gas line from its 1 Pirkle, in the Shields Survey, to its 1 Hudson, another outpost test for the Carthage area, in the Hanks Survey, northern Panola County, Texas. The 1 Pirkle, completed as a dual gas-condensate producer from both the upper and lower sections of the Pettit lime, is 5 miles southwest of Carthage.



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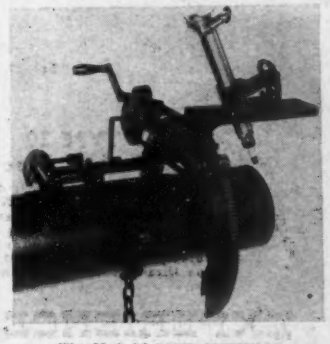

The H & M PIPE CUTTING and BEVELING MACHINE

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ECONOMY: Save approximately one-half labor and gas costs.

PORTABILITY: Can easily be carried from one pipe section to another.

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Available in 25 or 30 foot lengths

Select NORRIS QUALITY SUCKER RODS to meet your particular requirements with the assurance that you are buying maximum service at lowest cost.

TYPE 20
Carbon Steel

Recommended for regular to heavy loads where corrosive conditions are not a factor. These rods are giving excellent service, replacing in many instances competitive rods of supposedly higher grades steel. A. P. I. Specifications. Box & Pin and Double Pin.

TYPE 30
Carbon Manganese Steel

Recommended for extra heavy pumping conditions where corrosion is not a factor. CARBON-MANGANESE Steel to special Norris alloy specifications. Very high ultimate tensile strength, yield point and shock resistant qualities. Box & Pin and Double Pin.

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Nickel Molybdenum Steel

Recommended for wells where heavy loads are encountered and where irregularities in pumping movement are unavoidable. The NICKEL and MOLYBDENUM content in this rod aids materially in their resistance to corrosion fatigue. A. P. I. Specifications. Double Pin Type only.

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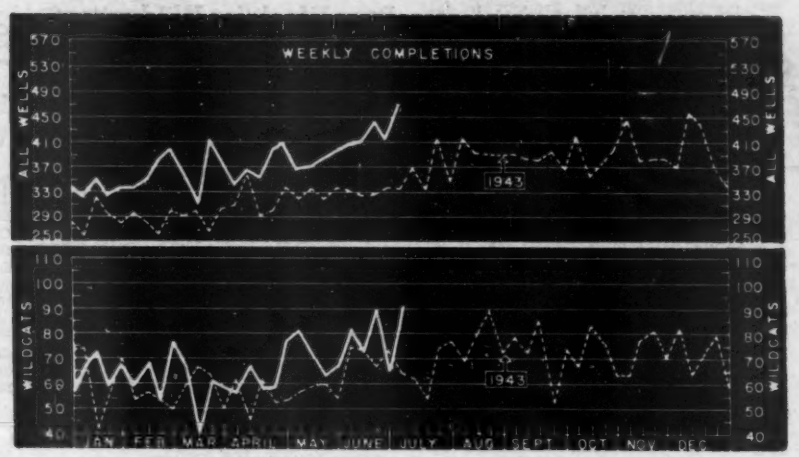
Exploration and Drilling

Week's Highlights

THE engineers call it "imagineering." Geologists have no particular equivalent name, but two newly completed successful wildcats have touched off the spark among some of these geologists; even though the new fields are separated by some 300 miles geographically, and are a few hundred million years apart in the geological age of the respective producing formations. By a coincidence, both were drilled by the same company. Continental Oil Co. 1-C Cramer, NW NW NE 11-6-27w, Sheridan County, Kansas, opened the new Adell pool, marking a new northwest extension of the long string of pools along the Central Kansas uplift. In the same week, Continental opened a new pool in eastern Wyoming, in Niobrara County, at 1 Wright, NW SW NW 25-36n-64w.

What sets the imagination of the geologists off into the future is the fact that the Central Kansas uplift is also a part of a major regional geological feature known as the Cambridge-Stockton Arch, which heads directly northwest from Central Kansas toward the Black Hills uplift and the Powder River basin in eastern Wyoming. What, they ask, is there to prevent us from finding, eventually, oil fields all along the arch, across western Nebraska and connecting up, or at least coming close to connecting up with the fields of eastern Wyoming?

They rest their case on the broad foundation that whatever peculiar combination nature requires to produce an oil field, once those conditions are found associated with a major regional geological feature, they have a tendency to persist over long distances and stratigraphically in the geological section. If it was permissible to dream of a 100-mile connection between Yates and Hendrick in West Texas, which came true over the years in a series of pools; if it was permissible to dream and still dream of a long series of pools along the Balcones fault zone, in Texas, in the days when it meant jumping 150 miles from Mexia to Luling, then why balk at a 300-mile jump?



Solid line charts current weekly completions

COMPLETIONS IN ALL FIELDS . . .
Week Ended July 1, 1944

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1944	1943
N. Y., Penna., W. Va.	48	17	4	69	121,038	1,567*	1,630
Ohio	3	9	6	18	51,657	456	401
Indiana	1	0	1	2	5,009	102	119
Kentucky	5	2	10	17	31,299	324	177
Illinois	24	0	27	51	140,099	846	833
Michigan	6	3	5	14	61,650	298	248
Kansas	21	1	23	45	148,549	860	768
Nebr., Mo., Iowa	0	0	0	0	0	15	21
Oklahoma	25	5	7	37	164,105	799	550
Texas:							
North Central	9	2	16	27	78,581	682†	611
West	39	0	7	46	206,976	756†	412
Panhandle	7	0	1	8	25,073	95†	88
Eastern	2	1	1	4	19,587	160†	136
Gulf Coast	15	2	15	32	234,511	541	209
Southwest	6	3	4	13	48,363	374	434
Total Texas	78	8	44	130	613,091	2,608†	1,890
Louisiana:							
Northern	4	1	1	6	32,270	138	152
Southern	6	0	1	7	60,287	226	173
Total Louisiana	10	1	2	13	92,557	364	325
Arkansas	3	0	2	5	29,109	102	120
Mississippi	3	0	1	4	32,552	58	48
Southeastern States	0	0	0	0	0	15	‡
Montana	5	0	6	11	32,134	152	95
Wyoming	3	0	0	3	17,974	79	54
Colorado-Utah	0	0	0	0	0	15	6
New Mexico	8	0	2	10	31,794	203	106
California	34	0	7	41	172,661	958	625
Total United States	277	46	147	470	1,725,258	9,821†	8,014
Total previous week	239†	36†	113†	388†			
Total July 3, 1943	190	28	116	334			

*Does not include 43 pressure wells. †Revised. ‡Included in total shown for Mississippi.

TEXAS GULF COAST

Smith Point Discovery Well Gaged for Final Completion

HOUSTON.—Standard Oil Co. of Texas 1-109 State-Galveston Bay, discovery well of the Smith Point field, Chambers County, flowed a potential of 250 bbl. daily through ⅛-in. choke for final completion. This well was brought in last February but it has been shut in pending storage facilities, etc. Sand was topped at 8,130 ft. Standard of Texas 2-109 State-Galveston Bay, northeast of the discovery well, and also shut in several weeks, flowed a potential of 256 bbl. daily through ⅛-in. choke, from perforations at 8,130-38 ft. for final completion. Sand was topped at 8,125 ft. Total depth is 8,173 ft. with 7-in. casing set to 8,169 ft.

Sinclair Prairie Oil Co. 1 A. J. Thompson, discovery well in Colorado County, was dual-completed flowing 59 bbl. of condensate daily with 738,000 cu. ft. of gas.

UPPER GULF COAST WILDCAT COMPLETIONS

Chambers County: Standard of Texas 1-103 State-Galveston Bay, 1½ mi. offshore at Smith Point, TD 8,626 ft., perf. 8,135-46 ft., PT 250 bbl. through ⅛-in. choke, gas-oil ratio 800, TP 1,100 l., gravity 42, no water. Smith Point discovery.

Colorado County: Sinclair Prairie Oil Co. 1 A. J. Thompson, 9 mi. NE of Columbus, TD 10,220 ft.; dual completion, perf. 8,177-82 ft., 73.45 bbl. through ¼-in. choke, gravity 54.8, 3,165,000 cu. ft. gas, CP 2,090 lb., gas-oil ratio 41,780-1, no water; perf. 9,288-93 ft., 59 bbl. through ¼-in. choke, 738,000 cu. ft., TP 720, gravity 58.9, gas-oil ratio 12,450:1. Discovery.

Grimes County: Northern Ordnance 1-A J. E. Quinn, 9 mi. SE of Navasota, dry at 7,515 ft.

Northern Ordnance 2-C J. M. Quinn, S. F. Austin Sur., dry at 3,850 ft.

Hardin County: Shell 1 Kirby Lumber Co. 4 mi. SW of Saratoga, dry at 9,097 ft.

Jefferson County: Glenn H. McCarthy 1 F. H. Carpenter estate, 3½ mi. S of South Lake, dry at 9,643 ft.

Matagorda County: Ohio et al 1 Heffelfinger & Hermanson, 4 mi. NE of Blessing, dry at 9,888 ft.

Walker County: W. E. Allaun 4 U.S.A. Central Coal & Coke Corp., 4 mi. NW New Waverly, dry at 7,042 ft.

KANSAS

Poor Week for Wildcatters 10 Completed—All Dry

KANSAS operators had another week of heavy completions, with 21 oil wells, 1 gas well and 23 dry holes, totaling 45; but all 10 wildcat completions were dry.

Top potential ratings of 3,000 bbl. per day were assigned to Shell Oil Co. 1 Knipp, NW SW SE 14-9s-21w, Morel pool in Graham County; Skelly Oil Co. 3 Johnson, NW SW 31-23s-10w, Zenith-Peace Creek pool of Reno County; and to the second well in the recently discovered St. John townsite pool of Stafford County, Stanolind Oil & Gas 2 Delker, SE NE NE 33-23s-13w. Panhandle Eastern Pipe Line Co. 1-A Kelly, NW 16-34s-38w, Hugoton gas field, Stevens County, was completed for an estimated 29,800,000 cu. ft.

WILDCAT COMPLETIONS

Dickinson County: Nelson Drilling 1 Sullivan, S½ SW NW 19-13-1e, dry, TD 3,299 ft., Arbuckle 3,261 ft.

Graham County: Texas 1 Fitch, SE SE SE 2-7-21w, dry, TD 3,740 ft., Arbuckle 3,682 ft.

Phillips County: Texas 1 Jackson, NE NE NW 31-4-18w, dry, TD 3,483 ft., solid Arbuckle 3,460 ft.

Rooks County: Barnsdall Oil 1 Zanoung, SE SE SW 20-9-17w, dry, TD 3,698 ft., solid Arbuckle 3,648 ft.

Rush County: Vickers and Atlantic Refining 1 Hermann, SW SW NE 12-16-18w, dry, TD 3,633 ft., Arbuckle 3,522 ft., basal sand 3,631 ft.

Russell County: Stanolind Oil & Gas 1 Sealey, SW SE SW 1-13-15w, dry, TD 3,403 ft., Arbuckle 3,228 ft.

Saline County: Max Cohen 1 Lindberg, NW SW SE 10-16-4w, dry, TD 3,686 ft., Viola 3,539 ft., sandy dolomite 3,644 ft.

Sedgwick County: Texas 1 Blackford, NE NE NE 24-25-2e, dry, TD 3,376 ft., Arbuckle 3,347 ft.

Sumner County: Texas 1 Craven, NE NE NW 27-33-2e, dry, TD 3,730 ft., Arbuckle 3,674 ft.

Trego County: Phillips Petroleum 1 Hacker, SE SE NE 12-13-23w, dry, TD 4,438 ft., Arbuckle 4,384 ft.

SOUTH LOUISIANA

Humble Finishes Discovery Well at College Point

NEW ORLEANS.—Humble Oil & Refining Co. has completed 1 Mrs. Rosa Roussell Keller et al, discovery well at College Point, St. James Parish, with perforations at 10,758-65 ft. where it flowed 8.56 bbl. an hour through ¼-in. choke of 46.5-gravity condensate. Total depth is 10,893 ft., with 7-in. casing set on bottom.

In the Krotz Springs area of St. Landry Parish, The Texas Co. 1 J. B. Ferguson is drilling ahead after setting 18⅝-in. conductor pipe to 128 ft. This is a scheduled 10,300-ft. test.

Continental Oil Co. 1 Fusilier, on the north edge of the Richie field, Acadia Parish, flowed potential of 90 bbl. daily through 8/64-in. choke from perforations in hte 8,600-ft. sand. Total depth is 8,638 ft.

LOUISIANA GULF COAST WILDCAT COMPLETIONS

Cameron Parish: Humble 1-B Cameron Parish School Board, Catfish Lake area, dry at 10,255 ft.

Magnolia 3 R. A. Moore, Gum Cove area, TD 10,242 ft. perf. 9,548-52 ft., 157 bbl. daily through ⅛-in. choke, gas-oil ratio 3,500, TP 2,500 lb., gravity 42.9.

MISSISSIPPI

Four Completions Mark Active Week

JACKSON.—Four wells were completed this week, including two producers in the Heidelberg pool of Jasper County; one in the Cranfield pool of Adams County; and one dry hole wildcat in Rankin County. This is almost double the first 6 months' average weekly completions, and indicates that the last half of the year will see a substantial increase.

Gulf Refining Co. 1 Morgan, SW SW 35-1n-12e, Heidelberg extension well, was completed, flowing 204 bbl. per day through tubing from perforations at 4,848-5,092 ft. Rogers Lacy 1 Travis, NW NE 32-1n-13e, also in the Heidelberg pool, was completed for 470 bbl., with pay zone given as 4,760-5,033 ft. The California Co. 6 Natural Gasoline Co. of Louisiana, in 53-7n-1w, Cranfield pool of Adams County, was completed for 358 bbl. flowing, from pay zone at 10,300-40 ft. Phillips Petroleum Co. 1 Denkman Lumber, SE SE 17-7n-4e, a Rankin County wildcat, was dry at 12,005 ft.

MISSISSIPPI WILDCAT COMPLETIONS

Rankin County: Phillips Petroleum 1 Denkman Lumber, SE SE 13-7n-4e, dry, TD 12,005 ft., elev. 388 ft., chalk —4,188 ft., Eutaw —5,308, Marine Tuscaloosa —6,492 ft., massive —6,730 ft., Comanche —7,172 ft.

DAILY AVERAGE PRODUCTION FOR WEEK

	July 1 crude oil	Distillate, allied products	June PAW quota all oils	June 24 crude oil
Arkansas	80,300	4,500	82,500	80,180
California	849,550	50,700	904,200	847,750
Colorado	7,850	.....	7,400	7,650
Eastern	67,000	6,200	77,400	69,300
Illinois	208,550	11,500	226,500	209,250
Indiana	12,850	.....	14,600	12,300
Kansas	274,700	5,000	279,000	289,700
Kentucky	21,800	2,200	24,200	20,800
Louisiana	361,550	45,000	395,000	362,940
North Louisiana	72,800	.....	.....	74,190
South Louisiana	288,750	.....	.....	288,750
Michigan	51,900	200	51,200	47,200
Mississippi	43,900	.....	41,000	45,200
Montana	24,400	300	24,700	23,050
Nebraska	1,000	.....	1,000	1,000
New Mexico	108,200	5,000	118,000	108,100
Oklahoma	338,300	27,000	359,000	332,300
Texas	2,036,400	140,000	2,204,000	2,036,400
East Texas field	360,550	.....	.....	360,550
East Central Texas	145,000	.....	.....	145,000
North Central Texas	149,400	.....	.....	149,400
Texas Panhandle	92,150	.....	.....	92,150
West Texas	447,900	.....	.....	447,900
So. Central (San Antonio)	19,650	.....	.....	19,650
South Texas (Laredo)	77,500	.....	.....	77,500
Lower Gulf Coast	215,800	.....	.....	215,800
Upper Gulf Coast	528,450	.....	.....	528,450
Wyoming	94,250	4,000	98,000	91,250
Total United States	4,582,500	301,600	4,907,700	4,584,370
Total production January 1-July 1, 1944				814,306,951 bbl.
Same period last year				713,277,225 bbl.

LA.-ARK.

Carter Opens Condensate Pool in Union County

MAGNOLIA, Ark.—Carter Oil Co. 1 Wilson, SW NW 33-16s-18w, just outside the Mount Holly townsite, definitely has opened a new condensate pool, to be known as the Salem Church pool. On test run, it produced 82 bbl. of water-white condensate of 71.5° corrected gravity, with 2,361,000 cu. ft. of gas, gas-condensate ratio of 29,000 to 1, hydrogen sulfide content of gas 94.6 grains per 100 cu. ft. This is the first purely gas-condensate pool for Union County.

The Carter well is 2 miles north of the Mount Holly pool, which produces 40°-gravity oil, and is apparently on a separate structure. About 1½ miles north of the Carter discovery, Northern Ordnance Inc. 1 J. B. Wells, a wildcat in 25-17s-18w, is drilling at about 7,200 ft., and the log is reported to indicate a different structure from the new Salem Church pool.

ARKANSAS WILDCAT COMPLETIONS

Union County: Skelly Oil 1 McGough, SE SW 22-17s-13w, dry, TD 4,204 ft.

OKLAHOMA

W. Edmond May Get Three Mile North Extension

A 3-MILE north extension of the West Edmond field into Logan County loomed as a possibility, as reports circulated that Phillips Petroleum Co. 1 Caven, NE NW 32-15n-4w, had cut 30-40 ft. of saturated core from the Bois d'Arc section of the Hunton lime. Casing has been set at approximately 7,220 ft., plug has been drilled out and tubing was being run to test. The Caven test is 2¾ miles north and 1 mile west of the nearest producing well in the field.

Mid-Continent Petroleum Corp. 1 Westermeier, NE SW SW 26-10n-3w, lived up to the most optimistic expectations and opened the new South Moore pool, approximately 3 miles east of the West Moore pool, by flowing 40 bbl. per hour of 43-gravity oil, with about 5,000,000 cu. ft. of gas per day through a 20/64-in. tubing choke, from the second Wilcox sand through perforations from 8,833-70 ft. Second Wilcox was topped at 8,825 ft., drilling stopped at 8,902 ft., still in the sand.

Jordan Petroleum Co. 1 Williams, SW SE SW 1-14n-1w, Arcadia pool opener, on second test, flowed 1,326 bbl. in 24 hours through a ¾-in. bottom-hole tubing choke with about 1,000,000 cu. ft. of gas. Production is from second Wilcox sand.

OKLAHOMA WILDCAT COMPLETIONS

Caddo County: Ray Stephens, Inc., 1 Lawrence, SW SW 21-7n-9w, dry, TD 9,663 ft., Medrano 9,556 ft.

Cleveland County: Sunray et al 1 Hardin, NE SE NE 31-10n-3w, dry, TD 8,965 ft., Hunton 8,060 ft., Bois d'Arc Hunton 8,067 ft., Sylvan 8,410 ft., Viola 8,520 ft., second Wilcox 8,910 ft.

Grant County: Northern Ordnance 1 Whitworth, NW NE SE 4-25n-3w, dry, TD TD 5,410 ft., Wilcox 5,352 ft., second Wilcox 5,397 ft.

Kay County: Chas. Jenkins et al 1 Peoples estate, SE SE NW 3-25n-2w, gas discovery, 10,000,000 cu. ft., pay zone 4,357-60 ft., TD 4,360 ft., Mayes 4,355 ft.

Oklahoma County: Atlantic Refining 1 Wickens, SE SE SE 13-12n-1w, dry, TD 6,322 ft., first Wilcox 6,193 ft., second Wilcox 6,302 ft.

Pontotoc County: Sinclair Prairie 1 Goff, NE SW SW 14-4n-7e, gas discovery, 2,000,000 cu. ft., pay zone 2,660-80 ft., TD 3,232 ft., PB to 2,680 ft., Oswego 2,611 ft., Prue 2,660 ft., Bartlesville 3,111 ft.

Stephens County: Texas 1 Cooper, SW SW SW 16-2n-8w, gas discovery, 9,000,000 cu. ft., perforations 4,743-85 ft., TD 6,396 ft., PB to 5,360 ft.

Watchorn Oil & Gas 1 Hildebrand, SW SE NW 1-3s-7w, dry, TD 2,151 ft.

Jackson Bros. 1 Allen, SE SE NW SE 14-3s-5w, dry, TD 1,100 ft.

CALIFORNIA

Buena Park Wildcat Still Subject of Speculation

LOS ANGELES. — General Petroleum Corp. has picked up some oil sand in its Buena Park wildcat 2 miles west of pioneer work done by The Texas Co. a few years ago, but the importance of the sand is not generally known. The sand was logged at about 10,950 ft. within 200 ft. of where it had been expected. Texas finished one small producer and drilled three dry holes before deciding the area did not warrant further work. General Petroleum's wildcat, 1 Heath, is a combination seismograph and geological location and the company may have found the main accumulation.

Operators interested in the southern end of the Greeley field in Kern County received a jolt when Standard Oil Co. of California abandoned its second outpost on the Wegis property, in 28-29s-26e, as a duster at 11,638 ft. and likewise abandoned a projected test on the Russell property. The first well on the Wegis lease produced under a natural flow but the second well failed to find the oil sand. Faulting of a major nature is suspected.

Tide Water Associated Oil Co. has revealed there is a lot of oil in the Kern River field despite the fact the field was discovered in 1899 and has produced approximately 290,000,000 bbl. of crude oil to date. Demand for heavy crude oil to meet the increasing need of fuel oil prompted Tide Water to undertake further development work. On the San Joaquin property the company has completed three wells averaging 63 bbl. daily from 1,055 ft. and on the Chicago Crude property it has finished one well equally as good. Production is cutting only about 7 per cent. Tide Water is undertaking additional drilling in this old field and completion of these exceptionally good wells is attributed in a large measure to work done by George Suman, district geologist and superintendent. The water level has been substantially reduced by Tide Water and Standard of California and this has helped all operators to produce smaller quantities of water and larger quantities of crude oil. This is a natural water-drive field and production activities must be maintained in order to keep ahead of the water.

CALIFORNIA WILDCAT AND OUTPOST COMPLETIONS

Dyer Creek outpost, Kern County: Shell 1 Glide, 13-26s-27e, dry at 2,166 ft.

Firebaugh outpost, Madera County: Texas 47-1 Moffat, 1-12s-14e, dry at 3,996 ft.

Maricopa outpost, Kern County: E. R. Bardwell 1 Sunset, 23-11n-24w, dry at 1,100 ft.

Rio Bravo outpost, Kern County: Richfield 1 Goosloo-Kern County Land, 20-29s-25e, abandoned at 10,236 ft.

Watson wildcat district, Los Angeles County: Selbar Oil Co. 1 Watson, 17-4s-13w, abandoned at 5,634 ft.

ROCKY MOUNTAIN

Another Discovery Made On Rim of Big Horn Basin

DENVER. — Another structure on the rim of the Big Horn basin in Wyoming and Montana was brought into production in Pioneer Oil Co. 1 Unit 1, C NE SW 12-45n-97w, Hot Springs County, Wyoming, a discovery on the Golden Eagle dome 18 miles northwest of Thermopolis, in the Muddy sand at 6,724-70 ft. In a 12-hour test through a choke on the tubing it made 3,500,000 cu. ft. of gas and 250 bbl. of 58-gravity oil. On a short wide-open test it indicated that it was capable of making 60 to 80 bbl. an hour. A drill-stem test in the Frontier at 5,768-5,871 ft., open 33 minutes, on the way down was estimated at 1,000,000 cu. ft. of dry gas.

The well marks a departure in Wyoming discoveries as it looks like a cycling field similar to those in Texas. The oil or condensate will be especially valuable in producing 100-octane gasoline. The well is shut in pending a decision as to whether it will be carried to deeper horizons.

Dry Creek wildcat testing.—Ohio Oil Co. 18 Northern Pacific, NE NE SW 3-7s-21e, Dry Creek field, Carbon County, Montana, was drilled to 8,883 ft. and tested the Madison at 7,170 ft., and the Jefferson lime at 8,125-8,420 ft. It then plugged back to the Tensleep and perforated the casing with 192 holes at 6,870-6,925 ft. On a 2-day swabbing test it made 25 to 30 bbl. of 28-gravity black oil and 150 to 250 bbl. of water per day. Swabbing failed to lower the fluid below 2,600 ft. Rotary tools have been moved off and pump will be installed for further test. It is standing with hole full of fluid and occasionally flows. The field produces oil and gas from the Frontier, Dakota and Lakota and this is the first test below those horizons.

Elk Basin extended. — Carter Oil Co. 1 Johnson, an Elk Basin outpost at the south end, ½ mile beyond the nearest producer, will make a small well. After cleaning up and experimenting to reduce the water, the production fluctuates considerably and on a 24-hour pumping test made 54 bbl. of oil and 96 bbl. of water.

WYOMING WILDCAT COMPLETIONS

Elk Basin, Park County: Carter Oil Co. 1 Johnson, NE NE SE 6-57n-99w, TD 5,963 ft., swabbed 138 bbl. water and emulsion from Tensleep on 24-hour test, after treating emulsion to clean up tank pumped 150 bbl. of fluid in 24 hours of which 54 bbl. was oil and 96 bbl. water.

Golden Eagle, Hot Springs County: Pioneer Oil Co. 1 Unit 1, C NE SW 12-45n-97w, TD 6,776 ft., in 12-hour test from Muddy sand at 6,724-70 ft., showed 3,500,000 cu. ft. of gas and 250 bbl. of 58-gravity oil or distillate through choke on tubing; on short test wide open indicated it would make 60 to 80 bbl. an hour.

MONTANA WILDCAT COMPLETIONS

Pondera, Pondera County: A. B. Cobb & Co. 1 Hirshberg, NE NE SW 23-27n-4w, TD 5,288 ft., top Devonian 2,935 ft., top Cambrian 3,994 ft., PB to Ellis-Madison 2,018-26 ft., acid 1,000 gal., dry.

Southwest Cut Bank, Glacier County: Hannah-Porter Co. 1 Marceau, NW SE NW 3-31n-6w, TD 3,284 ft., Ellis 3,092 ft., Madison 3,238 ft., PB to Cut Bank at 3,087-92 ft., shot show of 28-gravity oil, dry.

West Pendry, Teton County: Roy G. Anderson 1 Hanson, NW NW NW 21-27n-6w, TD 3,537 ft., Sunburst 3,150-75 ft., Ellis-Madison 3,513 ft., sulfur water, dry.

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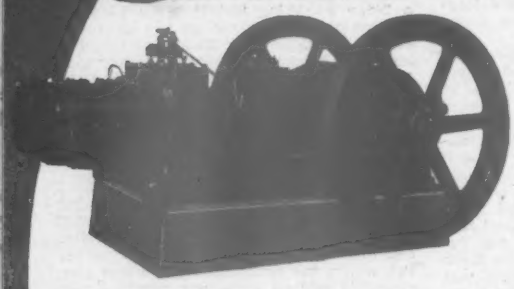

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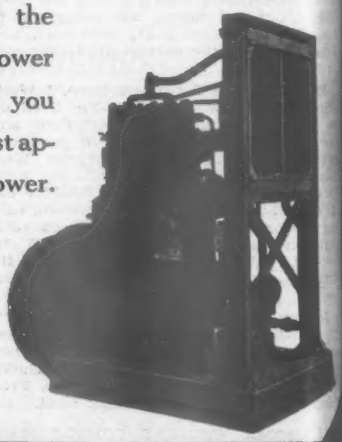

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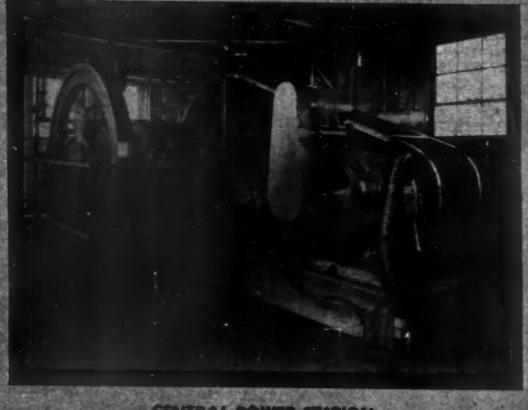

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ILLINOIS

14 Wildcat Completions in 13 Counties Are Dry

CENTRALIA, Ill.—The Schnell pool in Richland County supplied the only large new producer of last week's 24 new oil wells in Illinois. Pure Oil Co. 1 A. Martin, SW SE NE 24-3n-8e, started at 818 bbl. per day from acidized McClosky lime at 2,979-82 ft. and 2,986-94 ft., total depth 3,015 ft. Fifty-one wells were completed during the week but 27 of these were dry holes, including 14 wildcat tests in 13 counties.

The new operations started kept pace with the completions, a total of 51 starts having been rounded up. Of these Northern Ordnance Co. started six in Henderson County, which lies just east of the Mississippi River, the nearest oil pools being the old Plymouth-Colmar pools in McDonough County, opened about 1914. Plymouth at present is producing about 210 bbl. per day from Devonian lime lying at an average depth of 450 ft. The tests will be, or are being, drilled in 1-9n-5w, 17-9n-4w, 22-9n-4w, 35-8n-4w, 28-8n-4w, and 18-8n-4w.

Other new starts are J. H. Barton 1 Buint, NE NE NE 15-3n-5w, Hancock County; Texas 1 M. D. Smith, SE SE NE 16-4n-13w, and 1 Vangilder, SW SW NE 21-3n-13w, and Jake Cannon 1 Woodyard, SW NW NW 10-2n-12w, Lawrence County; Fox Brothers 1 Woodward estate, NE SE SE 33-2s-13w, Wabash County; Sohio 1-A Central Life, SE NE NW 10-7s-10e, White County; Pure 1 McBride, SW SE SE 16-3n-9e, Richland County; National Associated 2 Vada Johnson, NE SW SE 10-5s-7e, Hamilton County; Ben Nations 1 Bergman, NE NE NE 31-6n-4e, Effingham County; E. A. Obering, 1 Maxey, SE SW SW 18-2s-3e, Jefferson County; McBride, Inc 1 Jasper, SW SE NW 11-2s-3w, Washington County; L. C. Thorpe 1 M. Hostetler, SE NW NW 33-11n-4e, Shelby County.

ILLINOIS WILDCAT COMPLETIONS

Clinton County: Wiser et al 1 L. J. McAdams, SW NW SW 21-3n-1w, dry at 1,390 ft., Tar Springs 977 ft., Cypress 1,248 ft., Benoist 1,364 ft.

Edwards County: Calstar 1 Sheridan, SE SE NE 30-2s-10e, dry at 3,340 ft., Menard 2,402 ft., Benoist 3,057 ft., Aux Vases 3,180 ft., McClosky lime 3,240 ft.

Effingham County: Carter Oil 1 Scott, NW NE NE 20-9n-4e, dry at 2,010 ft., Tar Springs 1,438 ft., Glen Dean 1,480 ft., Aux Vases 1,784 ft., McClosky 1,893 ft.

Franklin County: Aetna and Oil Management 2 U. S. C. & C., SW NW SW 21-6s-4e, dry at 3,165 ft., upper Kinkaid 1,923 ft., Cypress 2,704 ft., Fredonia 3,114 ft.

Hamilton County: National Associated 1 Vada Johnson, NW SW SE 10-5s-7e, dry at 3,457 ft.; no log available; Cypress sand shot at 3,077-87 ft., was dry.

Jackson County: Magnolia 1 Reuscher-Froeling, NW SE SW 11-7s-4w, dry at 3,582 ft., small show of oil at 3,523-45 ft., no other formation data.

Jefferson County: Kingwood 1 M. B. McKeene, SW SE SW 14-4s-4e, dry at 3,494 ft., upper Glen Dean 2,648 ft., Cypress 2,906 ft., Weiler 2,938 ft., Benoist 3,074 ft., Aux Vases 3,211 ft., McClosky 3,361 ft., St. Louis 3,486 ft.

Skelly Oil 1 L. McNab, NW NE SE 34-4s-1e, dry at 2,953 ft., lower Kinkaid 1,768 ft., Cypress 2,468 ft., Benoist 2,704 ft., Aux Vases 2,749 ft., McClosky 2,895 ft.

Marion County: Texas 1 F. Carlisle, SE NE SW 9-3n-3e, dry at 2,568 ft., lower Kinkaid 1,508 ft., Cypress 2,154 ft., Benoist 2,258 ft., Aux Vases 2,308 ft., McClosky 2,438 ft.

Monroe County: G. A. Morris 1 Crowder, NW NW NE 16-2s-10w, dry at 904 ft.

Richland County: C. F. Frazier 1 Schlechenmyer, NW SE SE 19-3n-10e, dry at 3,197 ft., Glen Dean 2,504 ft., Weiler 2,764 ft., Benoist 2,923 ft., McClosky 3,101 ft.

Shelby County: P. D. Lynch 1 H. Amling, NE NE NW 20-12n-2e, dry at 1,679 ft., Aux Vases 1,493-1,506 ft., with a show of oil at 1,514-24 ft.

Wayne County: Pure 1 G. B. Garrison, NW NW SE 10-1n-7e, dry at 3,220 ft., Aux Vases at 3,010-36 ft. was shot with 310 qt. with no paying results.

White County: Allied Oil 1 Pearce, NW NW SW 11-7s-10e, dry at 2,988 ft., upper Kinkaid 1,722 ft., Cypress 2,554 ft., Benoist 2,700 ft., Aux Vases 2,826 ft., Fredonia 2,983 ft., St. Louis 2,983 ft.

OHIO, KENTUCKY

Ohio Fuel Completes Large Clinton Gasser

COLUMBUS.—The Ohio Fuel Gas Co. completed a 4,160,000-cu. ft. well on the R. B. Hanes farm in the southern part of Washington Township, Muskingum County. Top of the Clinton was logged at 3,988 ft., and drilling stopped at 3,994 ft., still in sand. East and west offsets to the well have been staked.

Hanley & Bird drilled in their fourth gas well, in Lot 84, the La Grange pool in Lorain County. Sand at 2,367-74 ft. had an initial volume of 1,270,000 cu. ft., and shut in after shot at 1,629,000 cu. ft.

H. K. Porter extended the south Wayne pool in Muskingum County ¾ mile southwest with a 798,000-cu. ft. well in Section 8. Sand was found at 3,777-3,800 ft and rocked to 1,150 lb. indicating a separate pay from the older part of the pool.

A 52-bbl. producer on the western edge of the Clayton pool was finished by the Pure Oil Co. on its J. A. Pargeon lease, Section 12, Reading Township, Perry County. There is still some undeveloped acreage in this part of the pool.

OHIO WILDCAT COMPLETION

Morgan County, Bloom Township: H. K. Porter 1 Maretta White, Sec. 2, Clinton 4,607-41 ft., dry; Medina 4,715-35 ft., dry; TD 4,735 ft.

WESTERN KENTUCKY

OWENSBORO, Ky.—Fifteen wells were completed in Western Kentucky during the week, but 10 of them were dry holes. The five producing wells averaged 130 bbl per well in initial production. One wildcat in Union County found production. Another was dry. Two Henderson County wildcats were dry.

WESTERN KENTUCKY WILDCAT COMPLETIONS

Henderson County: Otto L. Chase 1 Chase, SW SW SE 11-Q-26, 3 mi. S of Reed dry at 1,994 ft. Kinkaid 1,108 ft., Barlow 1,637 ft., Paint Creek 1,714 ft Renault 1,762 ft., McClosky 1,853 ft.

Sohio-Snyder 1 A. W. Griffin, SE SE NW 16-0-25, 4 mi. E of Robards, dry at 825 ft.

Union County: S. C. Yingling 1 H. R. Slack heirs, SW cor. Blk. 3, 20-P-18, 5 mi. W of Uniontown, dry at 3,063 ft. Lower Kinkaid 1,876 ft., Barlow 2,604 ft., Renault 2,830 ft., Ste. Genevieve 2,870 ft.

H. H. Weinert 2-B F. Greenwell, 12 0-20, 5 mi. SE of Uniontown, McClosky lime 2,581-93 ft., TD 2,601 ft. Pumped 120 bbl. of oil. Owner has a block of 3,000 acres.

EASTERN KENTUCKY

ASHLAND.—Eastern Kentucky drilling activity is on a higher level at midyear than it was at the start of the year. Kentucky-West Virginia Gas Co. 5515, on the J. Lee Ferguson tract on the right fork of Brushy Creek in Pike County, reached a total depth of 3,234 ft. and has a natural open flow of 3,736,000 cu. ft. of gas from shale. The same company completed 5526 on the A. J. Coburn land on Salt Lick Creek, in Knott County, at a total depth of 2,720 ft. The well has a daily open flow of 906,000 cu. ft. of gas from the Big lime.

INDIANA

EVANSVILLE, Ind.—An 85-bbl. well and a dry hole, both in Posey County, were reported as completions from Indiana fields in the past week.

INDIANA WILDCAT COMPLETION

Posey County: Farm Bureau 1 H. & J. Rosenbaum, SE SW SE 36-6s-13w, dry at 2,805 ft. Upper Kinkaid 1,647, Waltersburg 2,027 ft., Cypress 2,413 ft. Aux Vases 2,640 ft., McClosky, 2,685-2,780 ft. at intervals.

SOUTHWEST TEXAS

New Zavala Gas Area Receiving More Testing

CORPUS CHRISTI.—The Texas Co. is staking location for 2 Van Cleve in the new gas area in Zavala County, about 5,700 ft. north and west of the 1 Van Cleve discovery well.

Dirks Brothers 1 Booth, northeast outpost at Mineral field, Dee County, perforated at 7,802-32 ft., acidized and is flowing about 10 bbl. an hour, 50 per cent oil, rest water. In the West Tuleta-Wilcox area, Dirks Brothers completed 1 Robinson unit as a gas-condensate well, no gage with perforations at 7,516-34 ft.

On the southwest flank, of the Slick-Wilcox field, Goliad County, Transwestern 1 J. F. Wood, in Von Roeder Survey, perforated at 7,635-40 ft., flowed 9 bbl. hourly through 5/32-in. choke.

The area opened by Magnolia Petroleum Co. 1 Russell-Atkinson in Karnes County has been named Green field. Magnolia's second location, 2 Russell-Atkinson, in the Carlos Martinez grant, ran drill-stem test at 6,620-24 ft. and recovered 40 ft. of salt water and 10 ft. of mud in 30 minutes. Operators are coring ahead.

SOUTHWEST TEXAS WILDCAT COMPLETIONS

Brooks County: Sun 5 J. D. Cage et al, 3 mi. NE of Scott & Hopper field, dry at 7,946 ft.

DeWitt County: Arkansas Fuel Oil 1 Emil J. Boldt et al, 8½ mi. NW of Myersville, dry at 9,015 ft.

DeWitt County: Shell Oil Co., Inc. 1 Mrs. Alma Blackwell, P. F. Breeden Survey 6, dry at 10,431 ft.

Jim Hogg County: J. W. Gorman 1 W. H. Yaeger, 5 mi. W of Hebbronville, dry at 3,782 ft.

Lee County: Seaboard 1 O. Kissman est., 2 mi. S of Lincoln, dry at 4,495 ft.

Nueces County: Hewitt & Dougherty 1 Celestia Dobson, 5½ mi. NE of Richard King field, TD 6,252 ft.; gas, salt water, condensate-cut mud, PT gas well, no gage and shut in.

Victoria County: Edwin Neilson et al John Koutny, 7½ mi. S of Inez, TD 4,761 ft., perf. 4,759-61 ft., PT gas well, no gage, shut in, shut-in tubing pressure and casing pressure 2,050 lb. North Keeran discovery.

Zavala County: Texas 1 Wm. Van Cleve, 12½ mi. NW of Crystal City, TD 2,538 ft., perf. 1,960-65 ft., PT estimated 720,000 cu. ft. gas daily through 5/10-in. choke, TP 510 lb., SI TP 840 lb. Discovery.

EASTERN TEXAS

Southern Smith County Wildcat Prospect Testing

DALLAS.—Principal interest in the East Texas district was centered on Phillips Petroleum Co. 1 McMinn, southern Smith County wildcat, which was perforating and testing after cementing casing at 10,001 ft., total depth. Although no information is being released, it is believed that first perforations were made around 9,900 ft., and tubing was run. It is the opinion of some observers that the well will be a big gas and condensate producer.

Van Zandt County—Northern Ordnance, Inc. 1 Curtis Shelton, 1 mile southeast of Martin's Mill, topped Austin chalk at 3,898 ft., base Austin 4,287 ft., sub-Clarksville at 4,318 ft., and was drilling in Eagleford shale at 4,750 ft. This wildcat is being closely watched. Royalty was traded at fancy prices before operations were begun.

Wood County.—Gulf Oil Corp. 1 Hornbuckle, northwest outpost to the one-well Winnsboro pool, a Rodessa test, bottomed at 8,141 ft. in hard lime for repairs after coring tight ashy sand with no shows from 8,043-59 ft. The discovery well had Bacon lime at 7,990-8,014 ft., flowing 231 bbl. per day. Another failure for the Quitman pool is Shell Oil Co., Inc. and Delta Drilling Co. 1 Opal McIntosh, southwest edge of the field, which was abandoned in Glen Rose formation at 6,558 ft.

EAST TEXAS WILDCAT COMPLETIONS

Limestone County: Phillips and Keough 1 Oliver est., 14,700 ft. from NW, 330 ft. from SW, Pedro Varella Sur., elev. 565 ft., Pecan Gap 1,710 ft., Woodbine 3,444 ft., Paluxy 3,724 ft., Georgetown 3,768 ft., Massive anhydrite 4,650 ft., base massive 4,662 ft., Pettit 5,146 ft., dry, TD 5,363 ft.

MICHIGAN

Another Gusher Producer By Adams Township Pool

SAGINAW. — Arenac County's Adams Township oil pool produced another gusher last week with completion of Bolger & Rose 2 State in Section 14 for an estimated potential of 6,000 bbl. a day. Production is from 2,888 ft. in the Dundee.

Completions included six oil producers, three gas wells and five dry holes, four of which were wildcat tests. Producers included a well in the Fillmore pool of Allegan County where Regal Dutch Petroleum Co. acidized 2 Dykhuis for 480 bbl. a day, and a Midland County test where Chapman Oil Co. acidized 1 Crosby for 230 bbl. a day from the Detroit River sand. One of the smaller producers, C. W. Cook 1 Helder, Section 35, in Holland Township, Ottawa County, was a wildcat completion. Drilling in Traverse limestone, it acidized to 19 bbl. a day, with salt water.

MICHIGAN WILDCAT COMPLETIONS

Allegan County, Hopkins Township: Michigan Devonian Petroleum Co.-J. W. Lang, Inc., 1 Plogsterol et al, SE SE NW 8-3n-12w, dry at 1,615 ft.

Clinton County, Bingham Township: Arthur E. Williams 1 Andrews, SE NW NW 29-7n-2w, dry at 2,933 ft.

Midland County, Edenville Township: Chapman Oil Co. 1 A. R. Crosby, C S½ NE SE 15-16n-1w, dry at 4,064 ft.

Ottawa County, Holland Township: C. W. Cook 1 Helder, SE NW SW 35-5n-15w, pumping 19 bbl., TD 1,537 ft.

WILDCAT COMPLETIONS AND DISCOVERIES

	Week ended July 1, 1944					Cumulative total, 1944				
	Oil	Dist.	Gas	Dry	Tot.	Oil	Dist.	Gas	Dry	Tot.
Ohio	0	0	0	1	1	0	0	9	31	40
Indiana	0	0	0	1	1	3	0	0	11	14
Illinois	0	0	0	14	14	11	0	0	149	160
Kentucky	1	0	0	3	4	5	0	0	30	35
Michigan	1	0	0	3	4	5	0	1	117	123
Kansas	0	0	0	10	10	30	0	5	212	247
Nebraska-Missouri-Iowa	0	0	0	0	0	1	0	0	7	8
Oklahoma	0	0	3	6	9	23	0	15	124	162
Texas:										
North Central	1	0	1	8	10	30	0	1	140	171
West	0	0	0	6	6	*16	0	3	88	*107
Panhandle	0	0	0	0	0	0	0	0	4	4
Eastern	0	0	0	1	1	3	0	1	*67	*71
Gulf Coast	1	1	2	9	13	22	8	10	101	141
Southwest	0	0	1	2	3	15	4	11	126	156
Total Texas	2	1	4	26	33	*86	12	26	*526	650
Louisiana:										
Northern	0	0	0	0	0	2	0	0	28	30
Southern	1	0	0	1	2	4	5	0	31	40
Total Louisiana	1	0	0	1	2	6	5	0	59	70
Arkansas	0	0	0	1	1	2	0	0	27	29
Mississippi	0	0	0	1	1	2	0	0	32	34
Alabama-Georgia-Florida	0	0	0	0	0	2	0	0	7	9
Montana	0	0	0	3	3	2	0	1	13	16
Wyoming	2	0	0	0	2	10	0	1	8	19
Colorado-Utah	0	0	0	0	0	2	0	0	21	23
New Mexico	0	0	0	1	1	3	0	1	35	39
California	0	0	0	5	5	3	0	5	88	96
Total United States	7	1	7	76	91	*196	17	64	*1,497	1,774
Total previous week	*9	2	2	*83	66					

*Revised.

PERMIAN BASIN

Lamb County Wildcat Showing Oil in Clear Fork

MIDLAND.—Humble Oil & Refining Co. 1 Jackson, Section 119, Block A, R. M. Thompson Survey, wildcat test in extreme southeast Lamb County, ½ mile north of Hockley County line, was showing oil in dolomite in the top of the Clear Fork section of the Permian. First oil was encountered at 5,304 ft., and 40-minute drillstem test from 5,369-76 ft. recovered 10 ft. of oil-cut mud. Another test from 5,495-5,505 ft., recovered 4 ft. slightly oil-cut mud, and a core from 5,513-20 ft. recovered 7 ft. hard dolomite with scattered porosity and shows. It was coring below 5,520 ft. Elevation is 3,461 ft. The new prospect is 13 miles north of the Smyer pool, recent Clear Fork discovery in eastern Hockley County.

Gaines County.—Humble 1 M. S. Doss, Section 9, Block A-24, PSL Survey, 3½ miles northwest of the Robertson pool, elevation 3,343 ft., had a small show of oil and gas in core from 6,060-74 ft., in the San Angelo lime, below the San Andres and above the Clear Fork, which does not yet produce in this part of the Permian basin. Continental Oil Co. 1-A E. H. Jones, Section 22, Block A-7, PSL Survey, continues to test. It swabbed 44 bbl. of oil after perforations were made at 7,200-80 ft. and at 7,060-7,150 ft. Hole was then acidized with 4,000 gal.

Andrews County.—Two exceptional wells were completed in the Fuhrman pool. Shell Oil Co., Inc., and Cities Service Oil Co. 3 King flowed 1,412 bbl. per day, and Humble 4 Walker flowed 1,462 bbl. on potential test. An extension 1½ miles west of the Means pool was indicated at Sun Oil Co. 1 Gardner, Section 17, Block A-35, PSL Survey, which had 1,200 ft. of oil in the hole at 4,470 ft. Official potential on Stanolind Oil & Gas Co. 1-F University, discovery northeast of North Cowden pool, was 548.41 bbl. per day, 7 per cent water, from lime pay at 4,820-80 ft.

WEST TEXAS WILDCAT COMPLETIONS

Crane County: Magnolia Pet. 1 Mary Butler, C S¼ NE½ SW½ Sec. 6, Blk. 1, H&TC Sur., 5½ mi. E Abell pool, elev. 2,361 ft., Yates 1,220 ft., San Andres 2,300 ft., Simpson 5,310 ft., Ellenburger 5,954 ft., dry, TD 6,185 ft.

Loving County: Standard Oil Co. of Texas 1-4 W. D. Johnson, 660 ft. from S and E, Sec. 4, Blk. 56-1, T&P Sur., dry, TD 3,598 ft.

Standard of Texas 1-46 W. D. Johnson, 660 ft. from S and E, Sec. 46, Blk. 54-1, T&P Sur., dry, TD 4,568 ft.

Pecos County: Milton Unger 1 Bennett et al, 1,650 ft. from NE, 990 ft. from SE, Sec. 68, Blk. 10, H&GN Sur., elev. 2,445 ft., dry, TD 1,766 ft.

Terry County: Neville G. Penrose 1 Moore, NW NW Sec. 82, Blk. T, D&W Sur., 5 mi. NE Brownfield, dry, TD 5,571 ft.

Ward County: Bert Fields 1 University, 660 ft. from N and W, Sec. 21, Blk. 16, University Sur., elev. 2,607 ft., dry, TD 2,995 ft.

SOUTHEAST NEW MEXICO

HOBBS.—Three of Eddy County's seven completions for the week were in the

(Continued on page 175)

APPALACHIAN FIELD

Increased Operations Reported in Eastern Area

PITTSBURGH.—A considerable increase was noted in the number of completions reported in the lower eastern fields during the past week and also in wells now in the process of drilling.

In Williams district, Wood County, the Oriskany test of United Fuel Gas Co., on the Miriam S. Ashby farm resulted in a dry hole. It was void of any showing of oil, gas or water. The Oriskany sand was at 4,797-4,834 ft., TD 4,923 ft. In Union district, W. H. Wingrove completed 1 A. R. Wingrove, gaging 1,500,000 cu. ft. in the Berea sand. In Big Sandy district, Kanawha County, Rex Oil & Gas Co. completed 1 John Davis et al in the Berea sand, testing 1,205,000 cu. ft.

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